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1927

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SAFETY STANDARDS FOR THE PROTECTION OF THE HEAD, EYES, AND RESPIRATORY ORGANS

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UNITED STATES NAVY YARDS
AND NAVAL STATIONS

SAFETY STANDARDS

FOR THE PROTECTION OF THE

HEAD, EYES, AND RESPIRATORY ORGANS

SECRETARY'S OFFICE
NAVY YARD DIVISION
1927

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON
1927

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INTRODUCTION

These standards have been developed from the experience of qualified authorities on head, eye, and respiratory organs, protection necessary in various industrial pursuits, and by detailed investigation and study of material and equipment for safety protection at the material laboratory of the navy yard, New York.

Eye protection in the industries is one of the most important items in accident prevention. The eye is one of the most delicate organs of the body. Nature has made certain provisions for its protection, but these provisions are not sufficient when a person is engaged in the various eye-hazardous industrial activities, hence mechanical protection of one kind or another is necessary.

No one, except a person who has enjoyed the sight of two good eyes and who has lost the sight of one or both eyes, really understands what the loss of eyesight means. Close your eyes and ask yourself what life would be if you had to go through the remainder of your years in a world of darkness. Think of your loss in earning capacity and the suffering it would bring upon yourself and those depending upon you for support. Such a condition may be avoided, almost without exception, by the use of proper protectors.

If an employee's eye is injured in any way, he is to report the injury at once to his shop supervisor, or it is to be reported for him, if he is unable to do so; then he is to go or be taken to the dispensary for treatment. The removal of a foreign object from the eye of an employee by a fellow worker is prohibited. Avoid the so-called shop doctor, for in his honest endeavors to help his fellow worker he may cause serious injury to the employee's eye. The intentions of the so-called shop doctor are good, but his ability, medical knowedge, and conditions in the shop are vastly inferior to the qualified and experienced doctor with his assistant in the dispensary. Employees should not hesitate to go to the doctor at the dispensary for the treatment of any injuries they may receive in the course of their industrial activities.

Some men do not or will not use the necessary protectors for one reason or another. If it is a case of improper protectors or protectors not fitting properly, proper protectors or proper adjustment shall be provided. Apparatus for head, eye, and respiratory organs protection of good quality and modern design are provided for all Navy employees whose occupations require this protection, and must be worn by them when necessary. If it is a case of failure to wear protectors because of prejudice or willful disobedience, then proper disciplinary action shall be taken.

The need for employees of the naval establishments to use the necessary protection for the eyes that is provided for them is well illustrated by the safety reports from the 16 major navy yards and stations. During the calendar year of 1926, out of a total of 14,912

injuries, 3,583, or 24 per cent, were injuries to the eyes. Experience shows that a large majority of these eye injuries could have been prevented by the use of proper protectors.

Statistics from outside industrial plants, where the use of protectors has been systematically carried out, show that the number of eye injuries has been reduced in different establishments as much as 75 per cent. The naval establishments should do as well or better, and it will be done if all supervisors and men cooperate to the fullest extent in these safety endeavors for the proper protection of the eyes. Each man's effort may seem of small moment, but the efforts of all, in unity, are overwhelming. Do your part.

The respiratory organs receive more dangerous and harmful treatment in the industries than need be. Unlike the eyes, in many cases, the respiratory organs give no warning that they are being abused and the injury to them is oftentimes accumulative. Working conditions should always be investigated by the safety engineer or supervisors for dangers to the respiratory organs and corrected by the wearing of protectors if need be or by proper ventilation and other means.

Remember, when the eyes or respiratory organs are injured the whole physical body is influenced and impaired, so use the protection provided for them when hazards are present.

Throughout this code the word "shall" is to be understood as mandatory and the word "should" as advisory.

"Safety standards for head and eye protection" issued by the Secretary's office, Navy Yard Division, 1924, is superseded by this code.

These standards are intended to supplement, not nullify, any specific requirements of any bureau or bureau manual.

SAFETY STANDARDS FOR THE PROTECTION OF THE HEAD, EYE, AND RESPIRATORY ORGANS

Section I.—GENERAL REQUIREMENTS

Scope.

The following rules and directions apply to all industrial activities or processes which by reason of their nature present a possible hazard to the head, neck, face, eyes, and respiratory organs wherein injury, either temporary or permanent, may result, or the efficiency of the worker impaired through the presentation of a mental hazard through fear of injury.

Standard apparatus.

The types of apparatus listed herein have been tested, proven as to value, and approved by the Navy Department as standard for the necessary head, eye, and respiratory organs protection throughout the naval industrial divisions. All of this apparatus is covered in detail by Navy Department specifications. All apparatus used must be of a quality and type in full compliance with the Navy specifications and shall be used without question as herein directed.

Exceptions to the above rule may be made by the Secretary's office, Navy Yard Division, wherein it can be demonstrated that a particular operation or process can be more economically or expediently conducted by apparatus not specified in the code or specifications.

In such a case and before use by any naval establishment, a sample of the apparatus and complete description of the proposed operation, the number of men employed, and the reasons why specified apparatus will not suffice shall be submitted to the Secretary's office, Navy Yard Division, by the safety engineer of the establishment desiring to substitute the apparatus in question. The apparatus submitted will be tested, and if approved, may be used. This approval applies to the specific case only, and shall not establish a precedent for the universal use of the apparatus.

Procurement of apparatus.

Safety apparatus for head, eye, and respiratory organs protection is stocked at the navy yard, New York, and the navy yard, Mare Island. The navy yard, New York, is the purchasing yard and distributing point for all activities on the east coast. The navy yard, Mare Island, is the distributing point for all activities on the west coast and obtains its stock from New York, the purchasing yard.

All requisitions for safety apparatus of this type shall be to the distributing yard, where stock will be issued, or purchase will be made by the navy yard, New York, as the case warrants.

No direct purchase or procurement of apparatus shall be made by any yard or station, unless approved by the Navy Department.

In the case of special apparatus approved for specific use by the department, this may be procured as conditions in the case warrant.

All apparatus procured for Navy use shall comply strictly to all requirements of the Navy Department specifications. No material shall be held in stock which does not comply with these specifications.

All material complying with specifications is considered approved for service, and material not complying shall not be used under any conditions, unless specifically approved as noted above.

Duties of supervisors and employees.

Every supervisor shall see that every employee under his direction whose occupation requires protection for head, eyes, or respiratory organs, is provided with the correct and standard safety protective apparatus. The supervisor shall see that the protectors used by those working under his direction or control are in good condition and repair. The supervisor shall see that care is exercised in the adjustment of protectors used, so that a maximum of comfort, consistant with adequate protection, is obtained for the employees.

Every employee engaged in an occupation or any activities that present a hazard to the head, eyes, or respiratory organs shall use the proper apparatus provided for his protection. Employees shall not wear defective protectors, and shall be responsible for immediately reporting any broken, damaged, or otherwise defective protectors to their supervisors for repair or exchange.

Sterilization.

Protectors, after having been worn by an employee, shall be sterilized before reissuance to another employee. Protectors used by one person continuously shall also be sterilized at suitable intervals as required.

The following are methods of sterilization:

(*a*) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(*b*) Subject to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.

It is recommended the sterilization of protectors be done by a qualified member of the yard or station dispensary personnel or under his direction. The supervisor under whose direction the sterilization is being performed should make sure that the person or persons doing the sterilization thoroughly understands the procedure to be followed and the dangers incident thereto.

Interchanging of protectors between employees.

Protectors, except hand shields for welders, shall not be interchanged among employees unless the protectors have been sterilized between each change as noted above.

Occupations and processes requiring protection.

The safety engineer or supervisor must analyze the process or job for hazards and from the standard classified apparatus see that the proper protector is provided. There are several outstanding occupations that always require protectors such as sandblasters, foundry chippers, welders, etc., but in most occupations it is the process or job that decides if a protector is necessary and the type required, rather than the employees rating. Therefore a list of the occupations or ratings with protectors and type required are not given, but in the classification of apparatus that follows a complete description of the protectors and the nature of the protection they afford is given, from which the safety engineer or supervisor can be guided to properly protect the workmen.

Section II.—CLASSIFICATION OF APPARATUS AND SPECIFICATIONS

Class I.—Goggles for Protection Against Flying Particles and Chips

Types: (A) Eyecup. (B) Clip cups for use with corrective lenses. (C) Spectacle.

Goggles of this class are commonly known as chipper's goggles, being used by foundry chippers and similar occupations, where protection to the eyes is desired from relatively large flying particles and chips. Caulking, riveting operations, heavy grinding such as that done on rough castings and forgings, scaling, chipping, when using the air hose in cleaning machines and equipment of metal chips, etc. These examples are typical of the jobs or operations that require the use of the goggles of this class. These goggles and the lenses, are designed to withstand shock and impact, and are for the physical protection of the eyes.

Employees whose vision is such that they ordinarily wear glasses or corrective lenses, and their occupation or the job requires the use of goggles shall be provided with Type B of this class, which consists of a standard 40 millimeter spectacle frame, to be equipped with corrective lenses, and a set of clip cups, adapted to fit over the spectacle frame and protect the eyes and corrective lenses. The spectacle frames are furnished without the corrective lenses. The employee shall have these frames fitted with the type of corrective lenses that his eyes require, at his own expense, and the frames then become his property. This type of protectors is to be used by employees where protection and correction are necessary, but whose occupation or the job does not require protection from minute dust particles.

Where grinding wheels are used for light work, such as touching up tools, etc., the use of clear plate glass shields, constructed and installed in a safe and substantial manner, is recommended. The shields shall be so installed that flying particles of emery and metal will not strike the face or eyes of the operator. Where possible, clear wired plate glass should be used for the shields. When shields of the above character are used, the use of goggles is not required for touching up tools and similar light work.

[Navy Department Specifications 37G4, February 1, 1927]

Goggles for Protection Against Flying Particles and Chips

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at date of opening of bids, shall form part of these specifications.

TYPES

2. Equipment under these specifications shall include the eyecup type of goggles and protective cups for use in combination with spectacle frame equipped with prescription lenses.

MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) The materials used in the manufacture of apparatus under these specifications shall be those most suitable for the purpose. The materials shall be such that apparatus may be frequently sterilized, without deterioration, by the methods hereinafter covered.

(*b*) All metals used shall be inherently corrosion-resisting. Materials shall be nonirritating to the skin when subjected to perspiration. The materials shall be such as to combine mechanical strength and lightness of weight.

(*c*) Workmanship shall be of the best throughout. All metal parts shall have a smooth finish, free of sharp edges or any irregularities which might cut or scratch the user. The construction shall be sufficiently rugged to withstand rough handling and the service to which it will be subjected.

GENERAL REQUIREMENTS

4. See paragraph 5.

Eye-cup goggles

DETAIL REQUIREMENTS

5. (*a*) *Eyecup goggles.*—Eyecup goggles shall consist of two shallow eyecups held by a flexible, adjustable metal nose bridge and elastic headband for retaining the eyecups comfortably in place over the eyes.

(*b*) Headbands shall be at least ⅜ inch wide and may be either cotton elastic webbing or solid rubber. They shall be adjustable as to length, be fastened to the eyecups in such a manner as to be easily renewable, and not interfere with the facial fit of the eyecups.

(*c*) The eyecup shall be of such shape as to conform to the eye socket of the normal average face and be of such size and design as to completely cover the entire eye socket. The depth of the eyecup shall be the minimum, but such that the lens shall not touch nor interfere with the eyelashes of the wearer. Eyecup may be constructed of metal, fiber, or any material which is rigid, nonbrittle, noninflammable, and shall withstand sterilization as hereinafter specified. The eyecup shall be so designed as to furnish a total included angle of vision of not less than 105 degrees. The interior surface of the eyecup shall have a permanent nonreflecting surface, preferably oxidized black. The outside finish of the eyecup may be polished or dull, as desired. Where metal eyecups are used, the edges in contact with the face shall be suitably bound with special chrome-tanned leather, treated cambric, or material of equivalent cushioning

properties, securely fastened to the eyecup. This binding shall form a cushion at least $\frac{3}{16}$ inch at facial contact, and shall be so designed as to prevent cutting of the face by contact with the metal cup edge. When material other than metal is used in the eyecup construction, the edges of the cup need not be bound, provided the facial contact edge of the cup is not less than $\frac{3}{32}$ inch wide, is comfortable, and presents no possibility of injury to the face.

Eye-cup goggles

(*d*) Eyecups shall be adequately ventilated in such a way as to permit circulation of air from bottom to top of cup. The equivalent area of opening of ventilation in each cup shall be not less than the area of a 5/64-inch drill hole and no single opening shall be greater than 0.040 inch in diameter.

(*e*) The lens mounting shall be so designed as to accommodate the single type of lens hereinafter described. The seat width shall be adequate to support the lens under a strain sufficient to cause lens breakage. The lenses shall

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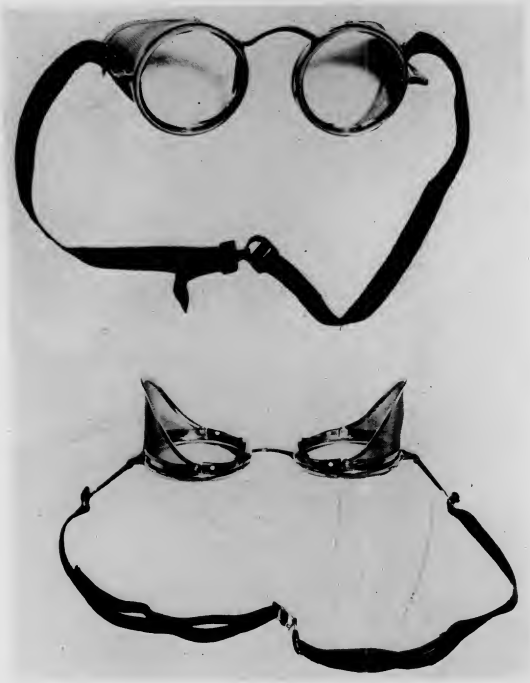
Eye-cup goggles

(*d*) Eyecups shall be adequately ventilated in such a way as to permit circulation of air from bottom to top of cup. The equivalent area of opening of ventilation in each cup shall be not less than the area of a ⅝-inch drill hole and no single opening shall be greater than 0.040 inch in diameter.

(*e*) The lens mounting shall be so designed as to accommodate the single type of lens hereinafter described. The seat width shall be adequate to support the lens under a strain sufficient to cause lens breakage. The lenses shall

be readily removable without the use of tools or injury to the lenses and eyecups.

(*f*) The nose bridge shall be of a flexible, adjustable metal type, and shall be so fastened to the eyecup that the distance from the inner lens surface to the point of anchorage of the bridge of the cup shall be not more than ⅛ inch. The maximum depth of the eyecup at the nose bridge shall not exceed ⅞ inch and the distance from the nose bridge frame fastening to the facial contact of the eyecup, directly in line with the nose bridge, shall be not less than $\frac{1}{16}$ inch.



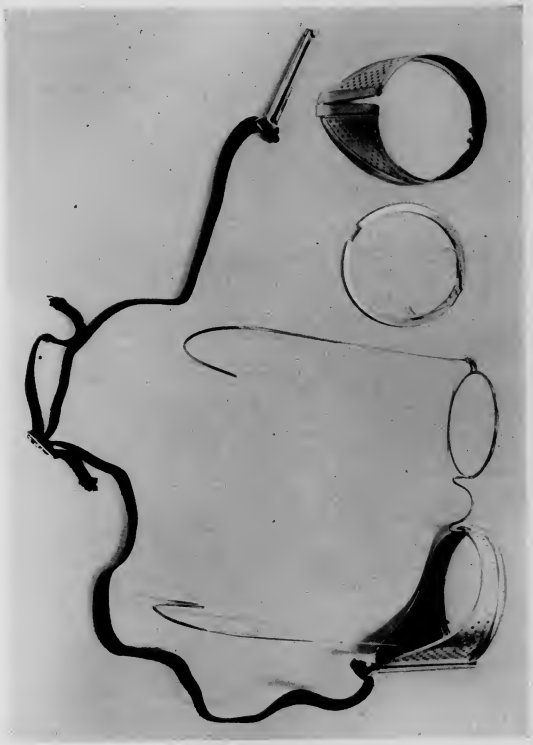
Clip-cup goggles

The nose bridge shall be covered with special chrome-tanned leather, treated cambric, or other suitable material. The maximum length of the adjustable nose bridge, between eyecups, shall be at least 1 inch. All binding and bridge covering shall be of material flame proof to a degree equivalent to that of rubber.

(*g*) *Cups to fit corrective lenses.*—The equipment under this type shall consist of two parts: The spectacle frame to be equipped with prescription lenses to suit the individual worker, and the protective cups to be attached to the spectacle frame.

(*h*) The spectacle frame shall consist of the standard 40-millimeter metal rim frame, with solid cylinder bridge and flat side temples. The spectacle frame shall be made of white metal most suitable for the purpose, and be of strong, substantial construction, suitable for shop use, and conditions it will be subjected to.

(*i*) The protective cups shall be similar to the eyecups previously described except as hereinafter covered. These eyecups shall be not more than ⅜

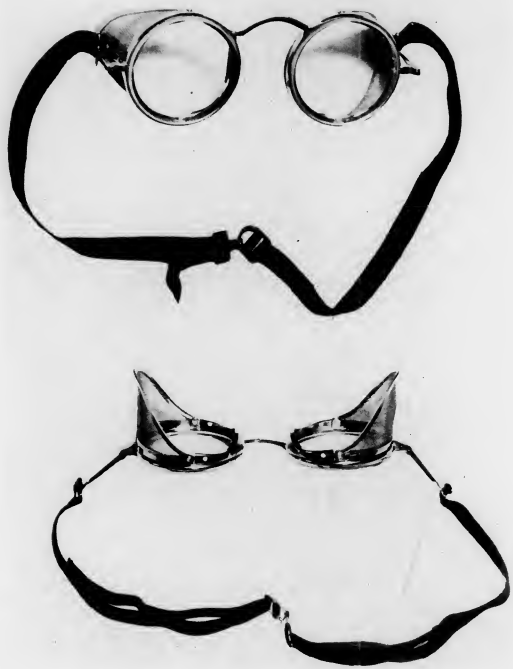


Clip-cup goggles parts

inch deep at the nose bridge, and not less than 1½ inches deep at the outer side. The inside of the cup shall be fitted with suitable clip springs, which shall form a solid and firm mounting whereby the cups can be held in place on the spectacle frames and be removable. The eyecups shall be unbound, but metal edges shall be turned back, forming a smooth edge to the face.

be readily removable without the use of tools or injury to the lenses and eyecups.

(*f*) The nose bridge shall be of a flexible, adjustable metal type, and shall be so fastened to the eyecup that the distance from the inner lens surface to the point of anchorage of the bridge of the cup shall be not more than $\frac{1}{8}$ inch. The maximum depth of the eyecup at the nose bridge shall not exceed $\frac{7}{8}$ inch and the distance from the nose bridge frame fastening to the facial contact of the eyecup, directly in line with the nose bridge, shall be not less than $\frac{7}{16}$ inch.



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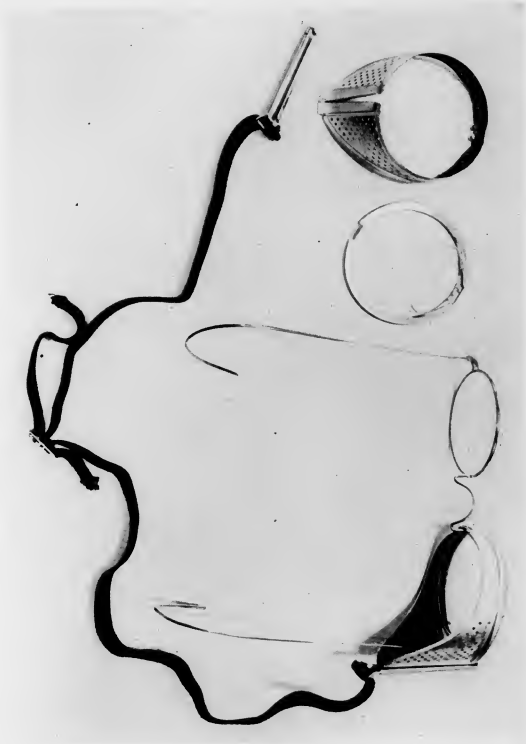

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inch deep at the nose bridge, and not less than 1½ inches deep at the outer side. The inside of the cup shall be fitted with suitable clip springs, which shall form a solid and firm mounting whereby the cups can be held in place on the spectacle frames and be removable. The eyecups shall be unbound, but metal edges shall be turned back, forming a smooth edge to the face.

These eyecups need not meet the dust-exclusion properties of the above-described eyecup goggles, but should be so designed as to furnish maximum protection from large dust particles and direct flying particles of large size impinging directly on the lens or at the side of the eye socket, which might cause eye injury. The cups shall be so designed as to accommodate the lenses hereinafter described. The eyecups shall be separate, without nose bridge, and shall be fitted with an elastic head band for furnishing support in addition to that provided by the spectacle temples.

(*j*) This equipment shall be furnished in sets consisting of two eyecups complete, with lenses, and a spectacle frame without lenses. The worker shall furnish his own correction lenses, have them fitted to the frame furnished, which shall become his own property. This type of protection is to be considered an expedient to be used only where protection and correction are necessary for workers whose occupation does not require protection from minute dust particles.

(*k*) Lenses for eyecup goggles and protective cups shall be the same, and shall measure not less than 1.75 inches in diameter and not less than 0.10 inch thick. The transmission of incident light shall not be less than 90 per cent.

(*l*) Lenses shall be made from single, solid glass plate of a grade suitable for optical use and of a high shock-resisting quality. The lens shall, when fractured, break normally, with cracks from point of impact to edge of lens. The lenses will be regarded as unsatisfactory if there is tendency to explode or scatter upon breakage.

(*m*) Lenses shall be free from visible or effective striae, waves, flaws, or any defect that will impair their optical quality. The optical surfaces of the lenses shall be free from visible surface scratches. Prismatic effect shall not exceed 2 minutes of arc as indicated by image displacement. The edges shall be beveled to a crown and shall be dull finished. All lenses shall be suitable for continuous use by the wearer without discomfort or optical impairment to the normal eye. If the lenses have a focus, the focus shall be uniform and shall not exceed ⅛ dioptre. The lenses shall be free from astigmatism and surfaces shall be smooth and uniformly plane to produce good definition of objects.

(*n*) Equipment shall be capable of being sterilized by either of the following methods, without deterioration:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.

(*o*) Material incapable of withstanding sterilization by either of these methods without deterioration will be rejected.

(*p*) *Resistance to corrosion.*—Metal parts shall be tested as to corrosion-resisting qualities by placing them in a boiling, 10 per cent (by weight) aqueous solution of sodium chloride for a period of 15 minutes. The parts, upon being removed from this solution, shall be immediately immersed in a 10 per cent (by weight) aqueous solution of sodium chloride at room temperature. They shall then be removed from this solution and, without having the adhering liquid wiped off, allowed to dry for 24 hours at room temperature. The metal parts shall then be rinsed in lukewarm water and allowed to dry. On inspection, the surfaces shall show no signs of corrosive action having occurred.

(*q*) All goggles, eyecups, spectacle frames, and lenses shall have a permanent, distinctive marking indicating name of manufacturer.

METHOD OF INSPECTION TESTS, ETC.

6. (*a*) Inspection of goggles, protective cups, spectacle frames and lenses shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the apparatus complies in all respects, with the specifications. If necessary, chemical examination of the eyecup binding shall be made to determine whether skin irritants are present.

(*b*) The goggles shall be worn by a person with average facial contour and fit comfortably and give adequate protection.

(*c*) The contractor shall furnish, in connection with the matter of inspection and tests, evidence indicating that the materials are free from skin irritants.

(*d*) *Optical tests for lenses.*—All lenses shall be examined for visible striae, waves, flaws, or any defect which would impair their optical quality. They shall be tested for effective striae, parallelism of optical surfaces, as indicated by prismatic effect, focus or axis, transmission of incident and visible light, and quality of surface regularity as indicated by clearness of image viewed through the lens with a 20-power telescope.

(*e*) *Physical test of lenses.*—Lenses shall have freely dropped upon them, from a height of 39 inches, a spherical steel ball, 0.565 ounce in weight, approximately 0.625 inch in diameter. The ball shall fall upon the center of the horizonal outer surface of the lens when held in its eyecup or goggle frame. Lense shall be supported in frame and frame supported on a wooden tube of a size to fit into the frame, securely holding the frame but not touching the lens. The lens shall then be removed from the frame and shall be seated flat on the tube end, unsupported. The inside diameter of tube shall be at least 1¼ inches, with $\frac{3}{16}$-inch walls. The test in the frame shall determine the suitability of the frame to properly distribute the shock of impact without chipping the edges of the lens. The test of the unsupported lens on the tube shall determine the strength of lens to impact. The lens under test shall not fracture not shall the edge chip. Upon a contract delivery, 1 per cent (minimum of one lens) of the total shall be subjected to the above drop test. If any lens fails under this test, a sufficient additional number of lenses shall be tested to determine whether the breakage was due to a defective individual lens or was characteristic of the material. Breakage of a single lens in itself will not constitute cause for rejection of the lot, but if additional tests show a tendency toward lack of uniformity of lenses or weakness in general, the breakage of a single lens may be considered sufficient cause for rejection of all material represented by that sample. The right is reserved to test each lens of a delivery, if desired.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) A suitable individual unlined metal container, strong, well made, with rounded corners, and capable of withstanding sterilization in boiling water, shall be furnished with each pair of goggles and each set of spectacle frames and protective cups. The equipment shall be shipped in this container.

(*b*) Lenses not installed in the apparatus shall be individually wrapped in lense paper.

(*c*) The apparatus shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure the delivery of material in undamaged condition.

(*d*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of sets of goggle equipment contained, contract or order number, and stock number, if this be stated in the contract or order.

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of the goggles under these specifications shall be to protect the eyes of the wearer from chips and flying particles and, in the case of the protective eyecups, to protect the eyes from injury from flying particles and furnish protection to the prescription spectacles of the wearer.

(*b*) In order to comply with paragraph 6 (*a*), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) Copies of Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

REFERENCES

C. & R. L2/JJ-37G4(S)N/C, Sept. 1 and Oct. 27, 1926.
Ord. L2-1(338)(Dm5-5), Sept. 14, 1926.
Y. & D. JJ-37G4, Sept. 16, 1926.
Aero. Aer-M-157-FAM QB(22), Sept. 23, 1926.
Navy Department Specifications Board, 37G4, Oct. 29, 1926.
S. & A. L2/JJ-37G4.

[Navy Department Specifications 37G7, July 1, 1927]

Goggles, Spectacle Type, for Protection Against Flying Particles and Chips

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at date of opening of bids, shall form part of these specifications.

TYPE

2. Goggles shall be of the spectacle type, equipped with short temples and head band, or full temples, as specified.

MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) The materials used in the manufacture of goggles under these specifications shall be new, unused, of enduring quality, and those most suitable for the purpose. The materials shall be such that the goggles may be frequently sterilized, without deterioration, by the methods hereinafter covered.

(*b*) All metals used shall be inherently corrosion-resisting. Materials shall be nonirritating to the skin when subjected to perspiration. The materials shall be such as to combine mechanical strength and lightness of weight.

(*c*) Workmanship shall be of the best throughout. All metal parts shall have a smooth finish, free of sharp edges or any irregularities which might cut or scratch the user. The construction shall be sufficiently rugged to withstand rough handling and the service to which it will be subjected.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) The goggles shall consist of two substantial lens frames or lens holders, with side shields, and be connected by a single bar nose bridge.

(*b*) The lens frame shall consist of a substantial reinforced rim, in which shall be fitted a lens seat, not more than $\frac{3}{32}$ inch wide, and of rigid construction. The seat may be discontinued for a space not exceeding ¼ inch at the hinge joint of the side shield, hereinafter described, if the design so requires. The lens frame shall be so designed as to accommodate a single lens of a type hereinafter specified. The lens shall be held firmly in the seat by means of a peripheral clamp fastened with screws. This clamp may be of the standard spectacle frame type, acting universally as a lens clamp and temple hinge, two separate screws being used, one for lens clamping and one for the temple hinge.

(*c*) Each lens frame shall be fitted with a side shield, which shall consist of a stamped metal frame with center reinforcing bar. In this frame a gauze screen of 40 square mesh shall be securely held. This side shield shall be mounted firmly to the lens frame by means of two hinged rivets, set approximately central on the diameter of the lens frame and so designed that the side shield can be hinged back on the goggle for compact packing. When in place for use the side shield shall not be less than 1¼ inches deep in line with the temple, tapered with an anatomical periphery, extending half way around the circumference of the lens frame and fit snugly around that frame. The edges of the side shields shall have a smooth finish or may be padded if the design permits. If padding or binding is used, it may be of chrome tanned leather or other approved material, as specified.

(*d*) The two lens frames shall be joined by a suitably shaped metal nose bridge This bridge shall be made of strong, ductile material of sufficient rigidity to hold any set adjustment and yet possess sufficient ductility to withstand repeated adjustment. The bridge shall be riveted to the lens frames and, in addition, shall be spot welded or hand soldered at the junctions of bridge and lens frame. A metal nose bridge shield shall be permanently secured to the lens frame and shall completely close all openings between the nose bridge and eye (cavity). This shield shall be anatomically shaped, with edges turned back to not less than $\frac{1}{16}$ inch.

(*e*) The goggles shall be equipped with either full flexible temples or short temples with head bands, as specified. The goggle shall be adaptable for use with either of these retaining devices. The short temple shall be adaptable to accommodate the head band hereinafter described. The full temples shall be of the standard commercial flexible type, made with a suitable securing bearing, and shall be easily adjustable by bending to fit the wearer. The full temple shall be of such design as to be comfortable and not cut into the flesh about the ear.

(*f*) Head bands shall be at least ⅜ inch wide and may be either cotton elastic webbing or solid rubber. They shall be adjustable as to length and be fastened to the short temples in such a manner as to be easily renewable without sewing in place. Head bands may be either the single-piece or two-piece type with catch.

(*g*) The goggles shall be finished in heavy nickel plate throughout, or if a suitable white metal is used in construction the natural metal finish may be used. The design of the goggles shall be such as to permit a total angle of vision of not less than 110°.

(*h*) Lenses for this goggle shall measure not less than 1.75 inches in diameter and not less than 0.10 inch thick. The transmission of incident white light shall be not less than 90 per cent.

(*i*) Lenses shall be made from single solid glass plate of a grade suitable for optical use and of high shock-resisting quality. The lens shall, when fractured by a point impact, break normally with cracks extending from the point of impact to the edge of the lens. The lenses will be regarded as unsatisfactory if there is any tendency to explode or scatter upon breakage.

(*j*) Lenses shall be free from visible or effective striæ, waves, flaws, or any defect that will impair their optical quality. The optical surfaces of the lenses shall be free from visible surface scratches. Prismatic effect shall not exceed two minutes of arc as indicated by image displacement. The edges shall be beveled to a crown and shall be dull finished. All lenses shall be suitable for continuous use by the wearer without discomfort or optical impairment to the normal eye. If the lenses have a focus, the focus shall be uniform and shall not exceed one-eighth dioptre. The lenses shall be free from astigmatism and surfaces shall be smooth and uniformly plane to produce good definition of objects.

(*k*) Equipment shall be capable of being sterilized by either of the following methods, without deterioration:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.

(*l*) Material incapable of withstanding sterilization by either of these methods without deterioration will be rejected.

(*m*) *Resistance to corrosion.*—Metal parts shall be tested as to corrosion-resisting qualities by placing them in a boiling 10 per cent (by weight) aqueous solution of sodium chloride for a period of 15 minutes. The parts, upon being removed from this solution, shall be immediately immersed in a 10 per cent (by weight) aqueous solution of sodium chloride at room temperature. They shall then be removed from this solution and, without having the adhering liquid wiped off, allowed to dry for 24 hours at room temperature. The metal parts shall then be rinsed in lukewarm water and allowed to dry. On inspection the surfaces shall show no signs of corrosive action having occurred.

(*n*) All goggles and lenses shall have a permanent distinctive marking indicating name of manufacturer.

(*o*) A suitable unlined linen metal container, strong, well made, with rounded corners, and capable of withstanding sterilization in boiling water, shall be furnished with each pair of goggles.

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) Inspection of goggles and lenses shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the apparatus complies, in all respects, with the specifications.

(*b*) The goggles shall be worn by a person with average facial contour and fit comfortably and give adequate protection.

(*c*) The contractor shall furnish, in connection with the matter of inspection and tests, evidence indicating that the materials are free from skin irritants.

(*d*) *Optical tests for lenses.*—All lenses shall be examined for visible striæ, waves, flaws, or any defect which would impair their optical quality. They shall be tested for effective striæ parallelism of optical surfaces, as indicated by prismatic effect, focus or axis, transmission of incident, and visible light, and quality of surface regularity as indicated by clearness of image viewed through the lens with a 20-power telescope.

(*e*) *Physical test of lenses.*—Lenses shall have freely dropped upon them from a height of 39 inches a spherical steel ball 0.565 ounce in weight, approximately 0.625 inch in diameter. The ball shall fall upon the center of the horizontal outer surface of the lens when held in its eye cup or goggle frame. Lens shall be supported in frame and frame supported on a wooden tube of a size to fit into the frame, securely holding the frame but not touching the lens. The lens shall then be removed from the frame and shall be seated flat on the tube end, unsupported. The inside diameter of tube shall be at least 1¼ inches, with $\frac{3}{16}$-inch walls. The test in the frame shall determine the suitability of the frame to properly distribute the shock of impact without chipping the edges of the lens. The test of the unsupported lens on the tube shall determine the strength of lens to impact. The lens under test shall not fracture nor shall the edge chip. Upon a contract delivery 1 per cent (minimum of one lens) of the total shall be subjected to the above drop test. If any lens fails under this test, a sufficient additional number of lenses shall be tested to determine whether the breakage was due to a defective individual lens or was characteristic of the material. Breakage of a single lens in itself will not constitute cause for rejection of the lot; but if additional tests show a tendency toward lack of uniformity of lenses or weakness in general, the breakage of a single lens may be considered sufficient cause for rejection of all material represented by that sample. The right is reserved to test each lens of a delivery if desired.

(*f*) *Physical test of nose bridge.*—The goggles shall be tested for flexibility of nose-bridge metal and general suitability of material for service. One per cent of each delivery (not less than one pair) shall be tested. The goggles with lenses in place shall be bent back until the outside surfaces of the lenses are pressed flat together, and then back again to normal position. This operation shall be repeated 10 times, each time restoring the goggles to normal position. At the conclusion of this test the nose bridge shall be unaffected as to usefulness, the anchorage of the bridge shall be intact, and the lens frame at the point of support shall be unaffected to any extent which will impair the continued use of the goggles in service.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) The goggles shall be shipped in the metal container covered by paragraph 5 (*o*).

(*b*) Lenses not installed in the goggles shall be individually wrapped in lens paper. Spare lenses shall be packed not more than 24 pairs in a substantial cardboard box, plainly marked for identification.

(*c*) The apparatus shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure the delivery of material in undamaged condition.

(*d*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of sets of goggle equipment contained, contract or order number, and stock number, if this be stated in the contract or order.

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of the goggles under these specifications shall be to protect the eyes of the wearer from chips and flying particles.

(*b*) In order to comply with paragraph 6 (*a*), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) Copies of Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

Class II.—Goggles, Rubber Frame, for Protection Against Liquids, Fumes, Fine Dust, and Powders

The goggles in this class are commonly known as chemists' goggles. These goggles are used to protect the eyes against harmful liquids, such as the splashing of acid in pickling operations, and alkalies in cleaning operations; also dust as encountered in cleaning back connections and combustion chambers, handling of sawdust, ashes, paint powders, chemicals, etc., and in some woodworking operations where fine sawdust is present.

The dust and paint spray respirators, later described, are such that they can be used in combination with this type of goggle, and there is no interference with the fit of either the goggles or respirator.

The use and purposes of this goggle are not to be confused with those of the goggles of Class I. The design of the eyecup, and the lenses not being hardened in order to resist the effects of hot acids, these goggles will not afford protection from the effects of mechanical shocks and impacts from relatively large flying particles and chips.

[Navy Department Specifications 37G5, February 1, 1927]

Goggles, Rubber Frame

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at date of opening of bids, shall form part of these specifications.

TYPE

2. Goggles shall be of the single piece, flexible, rubber frame type.

MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) The materials used in the manufacture of goggles shall be those most suitable for the purpose. Materials shall be such that goggles can be sterilized without deterioration.

(*b*) Materials shall be nonirritating to the skin when subjected to perspiration.

(*c*) The material shall be such as to combine mechanical strength, lightness of weight, and flexibility.

(*d*) Workmanship shall be of the best throughout. The construction shall be sufficiently rugged to withstand rough handling and the service to which the goggles will be subjected.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) The goggles shall consist of a single-piece rubber frame embodying two eyecups and a nose bridge. The rubber frame shall have an over-all length of not less than 9 inches. The rubber shall be made from a compound having all the characteristics of a compound containing at least 55 per cent, by volume, of washed and dried fine Para rubber, not more than 3½ per cent, by weight, of sulphur, and the remainder suitable, dry, inorganic filler, except that suitable organic accelerators may be used. The material shall be free from lead and mineral sulphates.

(*b*) The frame shall be equipped with an elastic, adjustable head strap for retaining the eyecups comfortably and tightly around the eyes. Elastic head bands shall be of a good grade, at least ⅝ inch wide, and may be either cotton elastic webbing or solid rubber.

(*c*) The lens socket shall be made to accommodate the lens hereinafter described and hold same firmly and gas tight. The removal and replacement of

lenses shall be such that it can be done without the use of tools or damage to the eyecups and lenses. The active lens surface shall be at least 1¾ inches in diameter. The effective angle of vision shall not be less than 100 degrees. The inner surface of the lenses shall be held at least ½ inch from the facial contact edge of the eyecup. The eyecups, when in place, shall cover the entire eye socket with at least ¼-inch wide bearing surface against the face.

(*d*) No ventilation shall be provided in these goggles, and when fitted to the face the contact shall be water-tight and gas-tight.

(*e*) Goggles may be sterilized by either of the following methods:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.

(*f*) Goggles incapable of withstanding sterilization by either of these methods without deterioration will be rejected.

(*g*) Lenses shall be of clear glass and measure not less than 2.125 inches in diameter and not less than 0.11 inch thick. The transmission of incident light shall be not less than 90 per cent. Lenses shall be unaffected by sudden changes of temperature between 40° and 150° F.

(*h*) Lenses shall be made from single, solid glass plate of a grade suitable for optical use. These lenses shall be free from visible or effective striae, waves, flaws, or any defect which would impair their optical quality. The

Rubber-frame goggles

optical surfaces of the lenses shall be free from visible surface scratches. The prismatic effect shall not exceed two minutes of arc as indicated by image displacement. The edges shall be beveled to a crown and shall be dull finished. All lenses shall be suitable for continuous use by the wearer without discomfort or optical impairment to the normal eye. If the lenses have a focus, the focus shall be uniform and shall not exceed one-eighth diopter. The lenses shall be free from astigmatism and surfaces shall be smooth and uniformly plane to produce good definition of objects viewed through them.

(*i*) Goggles and lenses shall bear some permanent, distinctive marking indicating the name of the manufacturer.

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) Inspection of goggles shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the apparatus complies in all respects with the specifications. If necessary, chemical examination of the rubber will be made to determine whether skin irritants are present.

(*b*) The goggles shall be worn by a person with average facial contour with water inclosed in the eyecups, and no water shall leak out at any position of the head.

(*c*) Optical tests of lenses: All lenses shall be examined for visible striae, waves, flaws, or any defect which would impair their optical quality. They

shall be tested for effective striae, prismatic effect, focus or axis, internal stresses, transmission of incident visible light, and quality of surface as indicated by clearness of image viewed through lens with a 20-power telescope.

(*d*) Lenses shall be tested, without injury, by being heated in water at a temperature of 150° F. for 3 minutes, then plunged into water at a temperature of 40° F.

(*e*) The contractor shall furnish evidence indicating that the materials of which the goggles were made are free from skin irritants.

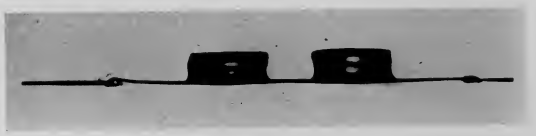
PACKING AND MARKING OF SHIPMENTS

7. (*a*) A suitable individual unlined metal container, strong, well made, with rounded corners, and capable of withstanding sterilization in boiling water, shall be furnished with each pair of goggles. The gogles shall be inclosed in these containers for shipment.

(*b*) Lenses not installed in the goggles shall be individually wrapped in lens paper.

(*c*) The goggles shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure the delivery of the goggles in undamaged condition.

(*d*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of goggles contained, number of contract or order, and the stock number, if this be stated in the contract or order.



Rubber-frame goggles

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of these goggles shall be to protect the wearer's eyes from fine dust, fumes, gases, or harmful liquids, and to afford a clear view. This type of goggles is not for use in protection from chips and flying particles, such goggles being covered in separate specifications.

(*b*) In order to comply with paragraph 6 (*a*), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) Copies of Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

REFERENCES

C. & R. L2/JJ–37G5 (S) N/C, Sept. 1 and Oct. 27, 1926.
Ord. L2–1(337) Dm5–5), Sept. 14, 1926.
Y. & D. JJ–37G5, Sept. 16, 1926.
Aero. Aer–M–157–FAM QB(22), Sept. 23, 1926.
Navy Department Specifications Board, 37 G5, Oct. 28, 1926.
S. & A. L2/JJ–37G5.

Class III.—Goggles, Welders

Goggles of this class, equipped with the proper lenses, are to protect the eyes of the wearer from intense visible light, injurious radiant energy, and molten metal spatter.

This type of goggle is primarily for the protection of the gas welder. The eyecups are deep in order to properly insulate the eyes from the heat, and ventilated in an approved manner to exclude all intense stray visible light or the entrance of fine molten metal spatter.

lenses shall be such that it can be done without the use of tools or damage to the eyecups and lenses. The active lens surface shall be at least 1¾ inches in diameter. The effective angle of vision shall not be less than 100 degrees. The inner surface of the lenses shall be held at least ½ inch from the facial contact edge of the eyecup. The eyecups, when in place, shall cover the entire eye socket with at least ¼-inch wide bearing surface against the face.

(*d*) No ventilation shall be provided in these goggles, and when fitted to the face the contact shall be water-tight and gas-tight.

(*e*) Goggles may be sterilized by either of the following methods:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.

(*f*) Goggles incapable of withstanding sterilization by either of these methods without deterioration will be rejected.

(*g*) Lenses shall be of clear glass and measure not less than 2.125 inches in diameter and not less than 0.11 inch thick. The transmission of incident light shall be not less than 90 per cent. Lenses shall be unaffected by sudden changes of temperature between 40° and 150° F.

(*h*) Lenses shall be made from single, solid glass plate of a grade suitable for optical use. These lenses shall be free from visible or effective striae, waves, flaws, or any defect which would impair their optical quality. The

Rubber-frame goggles

optical surfaces of the lenses shall be free from visible surface scratches. The prismatic effect shall not exceed two minutes of arc as indicated by image displacement. The edges shall be beveled to a crown and shall be dull finished. All lenses shall be suitable for continuous use by the wearer without discomfort or optical impairment to the normal eye. If the lenses have a focus, the focus shall be uniform and shall not exceed one-eighth diopter. The lenses shall be free from astigmatism and surfaces shall be smooth and uniformly plane to produce good definition of objects viewed through them.

(*i*) Goggles and lenses shall bear some permanent, distinctive marking indicating the name of the manufacturer.

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) Inspection of goggles shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the apparatus complies in all respects with the specifications. If necessary, chemical examination of the rubber will be made to determine whether skin irritants are present.

(*b*) The goggles shall be worn by a person with average facial contour with water inclosed in the eyecups, and no water shall leak out at any position of the head.

(*c*) Optical tests of lenses: All lenses shall be examined for visible striae, waves, flaws, or any defect which would impair their optical quality. They

shall be tested for effective striae, prismatic effect, focus or axis, internal stresses, transmission of incident visible light, and quality of surface as indicated by clearness of image viewed through lens with a 20-power telescope.

(*d*) Lenses shall be tested, without injury, by being heated in water at a temperature of 150° F. for 3 minutes, then plunged into water at a temperature of 40° F.

(*e*) The contractor shall furnish evidence indicating that the materials of which the goggles were made are free from skin irritants.

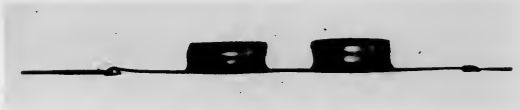
PACKING AND MARKING OF SHIPMENTS

7. (*a*) A suitable individual unlined metal container, strong, well made, with rounded corners, and capable of withstanding sterilization in boiling water, shall be furnished with each pair of goggles. The gogles shall be inclosed in these containers for shipment.

(*b*) Lenses not installed in the goggles shall be individually wrapped in lens paper.

(*c*) The goggles shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure the delivery of the goggles in undamaged condition.

(*d*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of goggles contained, number of contract or order, and the stock number, if this be stated in the contract or order.



Rubber-frame goggles

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of these goggles shall be to protect the wearer's eyes from fine dust, fumes, gases, or harmful liquids, and to afford a clear view. This type of goggles is not for use in protection from chips and flying particles, such goggles being covered in separate specifications.

(*b*) In order to comply with paragraph 6 (*a*), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) Copies of Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

REFERENCES

C. & R. L2/JJ–37G5 (S) N/C, Sept. 1 and Oct. 27, 1926.
Ord. L2–1(337) Dm5–5), Sept. 14, 1926.
Y. & D. JJ–37G5, Sept. 16, 1926.
Aero. Aer–M–157–FAM QB(22), Sept. 23, 1926.
Navy Department Specifications Board. 37 G5, Oct. 28, 1926.
S. & A. L2/JJ–37G5.

Class III.—Goggles, Welders

Goggles of this class, equipped with the proper lenses, are to protect the eyes of the wearer from intense visible light, injurious radiant energy, and molten metal spatter.

This type of goggle is primarily for the protection of the gas welder. The eyecups are deep in order to properly insulate the eyes from the heat, and ventilated in an approved manner to exclude all intense stray visible light or the entrance of fine molten metal spatter.

The goggles of Class I, with their shallow eyecups and method of ventilation, should never be used by the welders.

The various shades of filter lenses and their uses are listed in the transmission table of the specifications. For the majority of gas welding and cutting operations, U. S. N. shade No. 6 is to be used.

The use of goggles of this class by electric welders is limited to light electric spot welding and arc welding up to 30 amperes. Electric welders are afforded better and adequate protection by using the helmets and hand shields later described.

There are instances where gas cutting is performed, such as in ship breaking and cutting of painted surfaces, where it is necessary to provide protection for the respiratory organs as well as the eyes. Protection for such conditions is described under Class IX.

[Navy Department Specifications]

Goggles, Welders

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at opening of bids, shall form part of these specifications.

TYPE

2. Goggles shall be of the eyecup type.

MATERIAL AND WORKMANSHIP

3. (*a*) The materials used in the manufacture of goggles shall be those most suitable for the purpose. The materials shall be such as to combine mechanical strength and lightness of weight, be free from skin irritants, and be such that goggles can be frequently sterilized without deterioration.

(*b*) Workmanship shall be of the best throughout. The construction shall be sufficiently rugged to withstand rough handling and the service to which it will be subjected.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) These goggles shall consist of two eyecups joined by a flexible metal adjustable nose bridge and fitted with an elastic adjustable head strap for retaining the eyecups comfortably and tightly around the eyes.

(*b*) Eyecups shall be made of corrosion-resisting metal, which will withstand sterilization as hereinafter specified. The edges for facial contact shall be bound with rubber or material of equally suitable physical characteristics. This binding shall form a cushion at least $\frac{1}{16}$ inch in facial contact width, and shall be so designed as to prevent cutting of the face by contact with the metal cup edge. The eyecup shall be comfortable to the wearer and present no possibility of cutting or injuring the face. The interior surface of the eyecup shall have a permanent nonreflecting finish. The eyecup shall be of such shape as to conform to the contour of the eye socket of the normal average face. When in place on the wearer, the eyecup shall cover the entire eye socket and shall extend at least 1¼ inches backward from the lens at the side of the face and at least ⅝ inch at the section in line with the nose bridge. The eyecup shall be adequately ventilated in an approved manner to exclude all direct light not passing through the lens from a source in front of the wearer, and shall exclude all intense stray light which will be dangerous or disagreeable to the wearer.

(*c*) The eyecups shall have a suitable lens mounting designed to accommodate the filter and cover lenses hereinafter described. This mounting shall be so designed as to hold the lenses firmly in place and so that their removal and replacement can be easily accomplished without damage to the eyecup or lenses or without the use of tools.

(*d*) The eyecups shall be joined with a flexible metal adjustable nose bridge, If the chain type of nose bridge is used, it shall be covered with soft rubber or material of equally suitable physical characteristics. The spacing of the inner edges of the eyecups as controlled by the nose bridge shall not be less than 1 inch. All binding and bridge covering shall be of flame proof material to a degree equivalent to rubber.

(*e*) Elastic headbands shall be of the best commercial quality, at least ⅜-inch wide, and may be either cotton elastic webbing or solid rubber. They shall be adjustable as to length and be fastened to the eyecups in such a manner that they can be easily removed and replaced. The headbands shall not interfere with the facial contact of the eyecups.

(*f*) *Lenses.*—Lenses shall be made from single solid glass plate of a grade suitable for optical use and shall be optically finished as to surface. These lenses shall be free from visible or effective striae, waves, flaws, or any defect which would impair their optical quality. The optical surfaces of the lenses shall be free from visible surface scratches. Prismatic effect shall not exceed two minutes of arc as indicated by image displacement. The edges shall be beveled to a crown and shall be dull finished. If the lenses have a focus, the

Welders' goggles

focus shall be uniform and shall not exceed one-eighth dioptre. The lenses shall be suitable for continuous use by the wearer without discomfort or optical impairment to the normal eye.

(*g*) *Filter lenses.*—These lenses shall be solid plate colored glass and shall measure not less than 1.8 inches diameter and not less than 0.0825 inch thick. The density of the lens shall be uniform over its entire surface within 5 per cent of the densest part as measured by transmission of incident light. The limitations on the transmission of radiant energy shall be in accordance with Table 1 for shade numbers 3, 4, 5, or 6 as specified. These lenses shall possess maximum transparency between 525 m. u. and 600 m. u. and gradually increasing absorption of visible radiation on either side. These lenses shall furnish protection form ultra-violet rays and the intensity of visible light, afford an unobstructed view, and effectively filter the infra-red energy within limits of Table 1.

(*h*) *Cover lenses.*—These lenses shall be solid plate clear glass and shall measure not less than 1.75 inches diameter and not less than 0.036 inch thick. Cover lenses shall show a transmission of incident light of not less than 90 per cent and shall be unaffected by sudden changes of temperatures between 40° F. and 150° F. These lenses shall protect the filter lenses from molten spatter and afford an unobstructed view.

The goggles of Class I, with their shallow eyecups and method of ventilation, should never be used by the welders.

The various shades of filter lenses and their uses are listed in the transmission table of the specifications. For the majority of gas welding and cutting operations, U. S. N. shade No. 6 is to be used.

The use of goggles of this class by electric welders is limited to light electric spot welding and arc welding up to 30 amperes. Electric welders are afforded better and adequate protection by using the helmets and hand shields later described.

There are instances where gas cutting is performed, such as in ship breaking and cutting of painted surfaces, where it is necessary to provide protection for the respiratory organs as well as the eyes. Protection for such conditions is described under Class IX.

[Navy Department Specifications]

Goggles, Welders

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at opening of bids, shall form part of these specifications.

TYPE

2. Goggles shall be of the eyecup type.

MATERIAL AND WORKMANSHIP

3. (*a*) The materials used in the manufacture of goggles shall be those most suitable for the purpose. The materials shall be such as to combine mechanical strength and lightness of weight, be free from skin irritants, and be such that goggles can be frequently sterilized without deterioration.

(*b*) Workmanship shall be of the best throughout. The construction shall be sufficiently rugged to withstand rough handling and the service to which it will be subjected.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) These goggles shall consist of two eyecups joined by a flexible metal adjustable nose bridge and fitted with an elastic adjustable head strap for retaining the eyecups comfortably and tightly around the eyes.

(*b*) Eyecups shall be made of corrosion-resisting metal, which will withstand sterilization as hereinafter specified. The edges for facial contact shall be bound with rubber or material of equally suitable physical characteristics. This binding shall form a cushion at least ⅛ inch in facial contact width, and shall be so designed as to prevent cutting of the face by contact with the metal cup edge. The eyecup shall be comfortable to the wearer and present no possibility of cutting or injuring the face. The interior surface of the eyecup shall have a permanent nonreflecting finish. The eyecup shall be of such shape as to conform to the contour of the eye socket of the normal average face. When in place on the wearer, the eyecup shall cover the entire eye socket and shall extend at least 1¼ inches backward from the lens at the side of the face and at least ⅝ inch at the section in line with the nose bridge. The eyecup shall be adequately ventilated in an approved manner to exclude all direct light not passing through the lens from a source in front of the wearer, and shall exclude all intense stray light which will be dangerous or disagreeable to the wearer.

(*c*) The eyecups shall have a suitable lens mounting designed to accommodate the filter and cover lenses hereinafter described. This mounting shall be so designed as to hold the lenses firmly in place and so that their removal and replacement can be easily accomplished without damage to the eyecup or lenses or without the use of tools.

(*d*) The eyecups shall be joined with a flexible metal adjustable nose bridge. If the chain type of nose bridge is used, it shall be covered with soft rubber or material of equally suitable physical characteristics. The spacing of the inner edges of the eyecups as controlled by the nose bridge shall not be less than 1 inch. All binding and bridge covering shall be of flame proof material to a degree equivalent to rubber.

(*e*) Elastic headbands shall be of the best commercial quality, at least ⅜-inch wide, and may be either cotton elastic webbing or solid rubber. They shall be adjustable as to length and be fastened to the eyecups in such a manner that they can be easily removed and replaced. The headbands shall not interfere with the facial contact of the eyecups.

(*f*) *Lenses.*—Lenses shall be made from single solid glass plate of a grade suitable for optical use and shall be optically finished as to surface. These lenses shall be free from visible or effective striae, waves, flaws, or any defect which would impair their optical quality. The optical surfaces of the lenses shall be free from visible surface scratches. Prismatic effect shall not exceed two minutes of arc as indicated by image displacement. The edges shall be beveled to a crown and shall be dull finished. If the lenses have a focus, the

Welders' goggles

focus shall be uniform and shall not exceed one-eighth dioptre. The lenses shall be suitable for continuous use by the wearer without discomfort or optical impairment to the normal eye.

(*g*) *Filter lenses.*—These lenses shall be solid plate colored glass and shall measure not less than 1.8 inches diameter and not less than 0.0825 inch thick. The density of the lens shall be uniform over its entire surface within 5 per cent of the densest part as measured by transmission of incident light. The limitations on the transmission of radiant energy shall be in accordance with Table 1 for shade numbers 3, 4, 5, or 6 as specified. These lenses shall possess maximum transparency between 525 m. u. and 600 m. u. and gradually increasing absorption of visible radiation on either side. These lenses shall furnish protection form ultra-violet rays and the intensity of visible light, afford an unobstructed view, and effectively filter the infra-red energy within limits of Table 1.

(*h*) *Cover lenses.*—These lenses shall be solid plate clear glass and shall measure not less than 1.75 inches diameter and not less than 0.036 inch thick. Cover lenses shall show a transmission of incident light of not less than 90 per cent and shall be unaffected by sudden changes of temperatures between 40° F. and 150° F. These lenses shall protect the filter lenses from molten spatter and afford an unobstructed view.

(*i*) Goggles shall be sterilized by either of the following methods without deterioration:

(1) Immersion for 10 minutes in a solution made by placing 1 part of a 40 per cent formaldehyde solution in 9 parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.

(*j*) Goggles that can not withstand sterilizing without deterioration by either of these methods will be rejected.

Welders' goggles, parts

(*k*) All metal parts shall be tested for corrosion resistance by placing them in a boiling 10 per cent (by weight) aqueous solution of sodium chloride for a period of 15 minutes. The parts upon being removed from this solution shall be immediately immersed in a 10 per cent (by weight) aqueous solution of sodium chloride at room temperature. They shall then be removed from this solution and, without having the adhering liquid wiped off, allowed to dry for 24 hours at room temperature. The metal parts shall then be rinsed in lukewarm water and allowed to dry. On inspection the surfaces shall show no signs of corrosive action having occurred.

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) The inspection of goggles shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the apparatus complies in all respects with the specifications. If necessary, chemical examination of the eyecup binding, nose bridge binding and head band will be made to determine whether skin irritants are present.

(*b*) The goggles shall be worn by a person with average facial contour, fit comfortably, and give adequate protection.

(*c*) The contractor shall furnish evidence indicating that the material is free from skin irritants.

(*d*) Cover lenses shall be tested without injury by being heated in water 150° F. for a period of three minutes, then plunged into water having a temperature of 40° F.

(*e*) *Optical tests for lenses.*—All lenses shall be examined for visible striae, waves, flaws, or any defect which would impair their optical quality. They shall be tested for effective striae, parallelism of optical surfaces as indicated by prismatic effect, focus or axis, transmission of incident visible light and quality of surface regularity as indicated by clearness of image as viewed through lens with 20 power telescope. Filter lenses shall be tested as to whether they comply with Table 1 as to transmitting qualities by radiometer or equivalent suitable apparatus.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) All goggles and lenses shall bear some permanent distinctive marking indicating name of manufacturer. Each filter lens shall be marked with its shade number.

(*b*) A suitable individual unlined metal container, strong, well made, with rounded corners, and capable of withstanding sterilization in boiling water, shall be furnished with each pair of goggles. The goggles shall be enclosed in these containers for shipment.

(*c*) Lenses not installed in the goggles shall be individually wrapped in lens paper.

(*d*) The goggles shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure their delivery in undamaged condition:

(*e*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of goggles contained, number of contract or order, and the stock number, if this be stated in the contract or order.

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of these goggles, when fitted with proper lenses, shall be to protect the eyes of the wearer from ultra violet rays, intense visible light, infra red radiations above 700 m. u. and molten metal spatter.

(*b*) In order to comply with paragraph 6(a), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) The navy yard, Brooklyn, N. Y., is the distributing yard for all apparatus to protect the head, eyes, and respiratory organs for all points on the east coast and the navy yard, Mare Island. The navy yard, Mare Island, is the distributing yard for all points on the west coast and the Asiatic stations.

(*d*) Copies of Navy Department Specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

(*i*) Goggles shall be sterilized by either of the following methods without deterioration:

(1) Immersion for 10 minutes in a solution made by placing 1 part of a 40 per cent formaldehyde solution in 9 parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.

(*j*) Goggles that can not withstand sterilizing without deterioration by either of these methods will be rejected.

Welders' goggles, parts

(*k*) All metal parts shall be tested for corrosion resistance by placing them in a boiling 10 per cent (by weight) aqueous solution of sodium chloride for a period of 15 minutes. The parts upon being removed from this solution shall be immediately immersed in a 10 per cent (by weight) aqueous solution of sodium chloride at room temperature. They shall then be removed from this solution and, without having the adhering liquid wiped off, allowed to dry for 24 hours at room temperature. The metal parts shall then be rinsed in lukewarm water and allowed to dry. On inspection the surfaces shall show no signs of corrosive action having occurred.

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) The inspection of goggles shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the apparatus complies in all respects with the specifications. If necessary, chemical examination of the eyecup binding, nose bridge binding and head band will be made to determine whether skin irritants are present.

(*b*) The goggles shall be worn by a person with average facial contour, fit comfortably, and give adequate protection.

(*c*) The contractor shall furnish evidence indicating that the material is free from skin irritants.

(*d*) Cover lenses shall be tested without injury by being heated in water 150° F. for a period of three minutes, then plunged into water having a temperature of 40° F.

(*e*) *Optical tests for lenses.*—All lenses shall be examined for visible striae, waves, flaws, or any defect which would impair their optical quality. They shall be tested for effective striae, parallelism of optical surfaces as indicated by prismatic effect, focus or axis, transmission of incident visible light and quality of surface regularity as indicated by clearness of image as viewed through lens with 20 power telescope. Filter lenses shall be tested as to whether they comply with Table 1 as to transmitting qualities by radiometer or equivalent suitable apparatus.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) All goggles and lenses shall bear some permanent distinctive marking indicating name of manufacturer. Each filter lens shall be marked with its shade number.

(*b*) A suitable individual unlined metal container, strong, well made, with rounded corners, and capable of withstanding sterilization in boiling water, shall be furnished with each pair of goggles. The goggles shall be enclosed in these containers for shipment.

(*c*) Lenses not installed in the goggles shall be individually wrapped in lens paper.

(*d*) The goggles shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure their delivery in undamaged condition.

(*e*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of goggles contained, number of contract or order, and the stock number, if this be stated in the contract or order.

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of these goggles, when fitted with proper lenses, shall be to protect the eyes of the wearer from ultra violet rays, intense visible light, infra red radiations above 700 m. u. and molten metal spatter.

(*b*) In order to comply with paragraph 6(a), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) The navy yard, Brooklyn, N. Y., is the distributing yard for all apparatus to protect the head, eyes, and respiratory organs for all points on the east coast and the navy yard, Mare Island. The navy yard, Mare Island, is the distributing yard for all points on the west coast and the Asiatic stations.

(*d*) Copies of Navy Department Specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

TABLE NO. 1

No. 1	No. 2		No. 3	No. 4	No. 5	No. 6
U. S. N. shade	Visible transmittance; per cent visible radiation from source		Radiant energy transmitted; per cent of total above 700 m. u. (maximum)	Radiant energy transmitted; per cent of total between 330 m. u. to 400 m. u. (maximum)	Radiant energy transmitted; per cent of total source (maximum)	Normal uses
	Minimum	Maximum				
3	14.0	18.0	9.0	0.5	11.0	Reflected sunlight from snow, water, sand, etc.
4	5.0	8.0	5.0	0.3	6.0	Pouring and furnace work. Stray light from cutting and welding.
5	1.2	2.5	2.50	0.1	2.9	Light acetylene cutting and welding. Light electric spot welding.
6	0.40	0.90	1.50	0.05	1.8	Acetylene cutting and medium acetylene welding. Arc welding up to 30 amperes.

NOTES.—(*a*) Visible transmittance is based on the percentage of the visible radiations of a tungsten lamp operated at normal rating, determined photometrically.

(*b*) Glass shall show not less than 35 per cent of the total energy transmitted in the visible (400 m. u. to 700 m. u.) between wave lengths 525 m. u. and 600 m. u. Maximum peak of the visible energy curve shall fall between these limits. This determination shall be made radiometrically.

(*c*) Glass of shades listed above shall show a radiant energy cut-off not lower than 330 m. u.

(*d*) Radiometric energy determinations are made using as a light source a tungsten incandescent filament lamp, operated at normal commercial rating of temperature as indicated by rated current and voltage.

(*e*) In goggle lenses, the transmittance shall be matched to within 15 per cent for the two lenses.

Class IV.—Helmets and Hand Shields for Electric Welders

The apparatus of this class, equipped with the proper lenses, is primarily for the protection of electric welders.

The use of "homemade" shields, constructed of nonfireproof materials, containing light leaks, equipped with any colored glass for lenses, and otherwise not complying with the specifications, shall not be used.

The Navy has made intensive tests and investigations of filter lenses for both the welders' goggles and the electric-welders' helmets and hand shields. Filter lenses obtained through and inspected at the navy yard, New York, shall be used. Samples of filter lenses previously obtained through other sources or of doubtful origin should be submitted to the navy yard, New York, for test, and if they comply with the specifications, they may be used.

The normal uses of the various U. S. N. shades of filter lenses are given in the transmission table of the specifications. For most general purposes a No. 8 shade can be used in a hand shield and a No. 10 or No. 12 in the helmet.

To protect others than those actually engaged in electric welding from exposure to the radiation from the electric arc, a guard or shield, painted a flat black, and of sufficient size to inclose or shield the welder, shall be used. No employee shall be required to work in such a position or location that his face or eyes are exposed to the radiation of the electric arc.

It is strongly recommended that suitable permanent inclosures painted a flat black be supplied, where practicable, for arc welding and cutting.

Suitable signs calling attention to dangers of viewing the electric arc with the naked eye shall be posted in conspicuous places immediately adjacent to the place where the electric welding or cutting is being performed.

[Navy Department Specifications]

HELMETS AND HAND SHIELDS, WELDING

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at date of opening of bids, shall form part of these specifications.

2. Welding helmets and hand shields shall be of but one type.

MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) Materials used in the manufacture of helmets and hand shields shall be those most suitable for the purpose and such that the helmets and hand shields may be frequently sterilized by the methods hereinafter covered.

(*b*) Materials used shall be such as to combine mechanical strength and lightness of weight and be free from skin irritants.

(*c*) Workmanship shall be of the best throughout. All parts shall be finished smoothly, free from sharp edges or any irregularities which might cut or scratch the user. The construction shall be sufficiently rugged to withstand rough handling and the service to which it will be subjected.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) *Helmts.*—The helmet shall consist of a shield supported on the head of the wearer by an adjustable head harness and completely protecting the face, neck, and top of head to back of the ears, and fitted with a lens mounting.

(*b*) The helmet shall be so designed as to facilitate a direct view of the work without removing the helmet from the head. Materials of construction shall be rigid, nonconductors of electricity, flame proof and heat insulating. If two or more sections of material are used, the joints shall be butted, and over the joints a reinforcing strip at least ¾-inch wide shall be fitted, and the material shall be securely riveted to this strip. The entire construction shall be free of light leaks. When in place on the head, the helmet shall be supported at its upper section on the head harness, and the lower edge shall rest on the upper chest of the wearer. All interior parts of the helmet shall have a permanent, nonreflecting finish.

(*c*) The head harness shall retain the helmet comfortably and firmly in place on the head and be adjustable to permit setting of the lens in the line of vision of the wearer.

(*d*) The lens mounting shall be designed to accommodate the filter and cover lenses hereinafter described. These lenses shall be held firmly in place in the lens mounting. The removal and replacement of lenses shall be easily accomplished, without damage to the lens mounting or the lenses and without the use of tools.

(*e*) *Hand shields.*—The hand shield shall be similar to the helmet in material, construction, and lens mounting, except as hereinafter modified:

(*f*) The shield shall not be less than 11 inches square. The face of the shield shall be flat, and the sides and top shall be bent backward to a depth of not less than 4 inches. At the bottom of the shield shall be fitted a suitable heat-insulating flame-proof handle not less than 5 inches long and 1¼ inch in diameter. Where material is joined, it may be lapped not less than 1 inch or butt-joined in a manner similar to that described for the helmets in paragraph 5 (b), but in either case, shall be securely riveted. When the shield is held in front of the operator by the handle, it shall completely protect the face and ears.

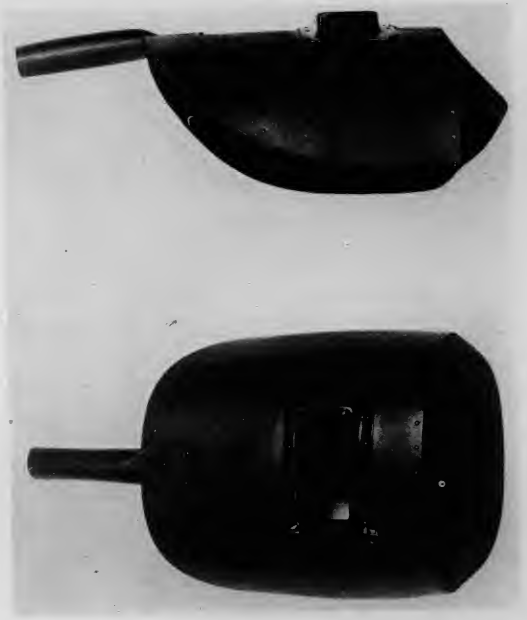
(*g*) Lenses for helmet and shield windows shall be made from glass of a grade suitable for optical use, and shall be optically finished as to surface. The surfaces shall be free of focus to one-eighth dioptre and shall be effectively free from prism as judged by image displacement, to five minutes of arc, at

Welding mask

any point on the surface or cumulative over the surface. Glass shall be free from visible or effective striae, wrinkles, or streaks which would impair the optical qualities of the window or impair its appearance. Bubbles and pits in the filter glass, if not farther than ⅜-inch from any edge and in small

number are permitted. The opposite edges of the lenses shall be parallel within $\frac{1}{16}$ inch.

(*h*) *Filter lenses.*—These lenses shall be of solid plate colored glass and shall measure 2 inches ± $\frac{1}{32}$ inch high by 4¼ inch ± $\frac{1}{32}$ inch long and not less than 0.10 inch thick. Filter lenses shall be furnished in U. S. N. shade numbers 8, 10, 12, or 14, as specified, according to Table 1. These lenses shall furnish protection from ultra violet rays, intensity of the visible light, and shall effectively filter the infra red energy within the limits of Table 1, and afford an unobstructed view and protection in acetylene and art welding, cutting, and kindred work to the capacity listed in Table 1.



Welding hand shield

(*i*) *Cover lenses.*—These lenses shall be of solid plate clear glass and shall measure 2 inches±1/32 inch high by 4¼ inches+1/32 inch long and not less than .035 inch thick. Cover lenses shall show a transmission of incident light of not less than 90 per cent and shall be unaffected by sudden changes in temperature between 40° F. and 150° F. These lenses shall protect the filter lenses from damage by molten metal spatter and afford an unobstructed view.

(*j*) Helmets and shields shall be capable of being sterilized by either of the following methods without deterioration:

(1) Immersion for 10 minutes in a solution made by placing one part of 40 per cent formaldehyde solution into 9 parts of water.

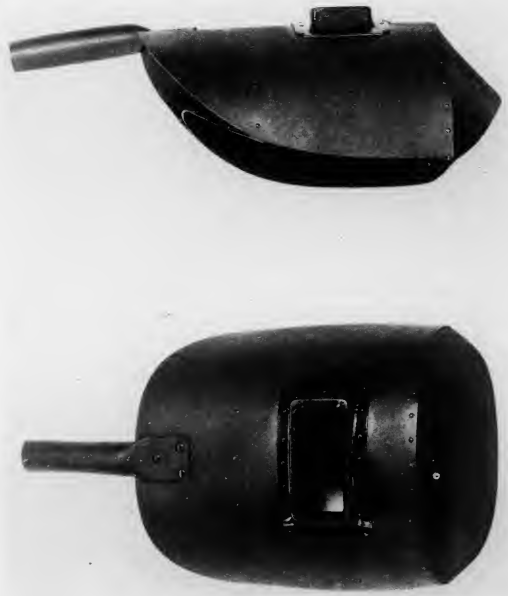
(*g*) Lenses for helmet and shield windows shall be made from glass of a grade suitable for optical use, and shall be optically finished as to surface. The surfaces shall be free of focus to one-eighth dioptre and shall be effectively free from prism as judged by image displacement, to five minutes of arc, at

Welding mask

any point on the surface or cumulative over the surface. Glass shall be free from visible or effective striae, wrinkles, or streaks which would impair the optical qualities of the window or impair its appearance. Bubbles and pits in the filter glass, if not farther than ⅜-inch from any edge and in small

number are permitted. The opposite edges of the lenses shall be parallel within $\frac{1}{16}$ inch.

(*h*) *Filter lenses.*—These lenses shall be of solid plate colored glass and shall measure 2 inches $\pm \frac{1}{32}$ inch high by 4¼ inch $\pm \frac{1}{32}$ inch long and not less than 0.10 inch thick. Filter lenses shall be furnished in U. S. N. shade numbers 8, 10, 12, or 14, as specified, according to Table 1. These lenses shall furnish protection from ultra violet rays, intensity of the visible light, and shall effectively filter the infra red energy within the limits of Table 1, and afford an unobstructed view and protection in acetylene and art welding, cutting, and kindred work to the capacity listed in Table 1.



Welding hand shield

(*i*) *Cover lenses.*—These lenses shall be of solid plate clear glass and shall measure 2 inches±1/32 inch high by 4¼ inches+1/32 inch long and not less than .035 inch thick. Cover lenses shall show a transmission of incident light of not less than 90 per cent and shall be unaffected by sudden changes in temperature between 40° F. and 150° F. These lenses shall protect the filter lenses from damage by molten metal spatter and afford an unobstructed view.

(*j*) Helmets and shields shall be capable of being sterilized by either of the following methods without deterioration:

(1) Immersion for 10 minutes in a solution made by placing one part of 40 per cent formaldehyde solution into 9 parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, proferably formaldehyde, for a period of 10 minutes.

(*k*) Helmets and shields that can not withstand sterilization without deterioration by either of these methods shall be rejected.

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) Inspection of helmets and hand shields shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the helmets and hand shields comply in all respects with the specifications. If necessary, chemical examination will be made of materials coming in contact with the skin to determine whether skin irritants are present.

(*b*) The contractor shall furnish evidence indicating that the materials are free from skin irritants.

(*c*) *Optical tests for lenses.*—All lenses shall be examined for visible striae, waves, flaws, or any defect which will impair their optical quality. They shall be tested for effective striae, parallelism of optical surfaces as indicated by prismatic effect, focus or axis, transmission of incident visible light, and radiant energy transmission. Filter lenses shall be tested as to whether they comply with Table 1 as to transmitting qualities by radiometer or equivalent suitable apparatus.

(*d*) Cover lenses shall be tested without injury by being heated in water (150° F.) for a period of three minutes, then plunged into water having a temperature of 40° F.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) All helmets, shields, and lenses shall bear some permanent distinctive marking indicating name of manufacturer. Filter lenses shall be marked with shade number.

(*b*) Lenses not installed in the helmets or shields shall be individually wrapped in lens paper.

(*c*) Helmets and shields shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure their delivery in undamaged condition.

(*d*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of helmets and hand shields contained, number of contract or order, and the stock number, if this be stated in the contract or order.

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of the helmet shall be to protect the face, head, and neck from heat and injurious radiant energy encountered in any acetylene welding and cutting or all welding and cutting arcs up to 500 amperes rating. The shield shall give to the face and ears protection similar to that for which the helmet is designed and may be used in any acetylene welding and cutting, or arc welding and cutting, up to 100 amperes.

(*b*) In order to comply with paragraph 6 (*a*), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) The navy yard, Brooklyn, N. Y., is the distributing yard for all apparatus to protect the head, eyes, and respiratory organs for all points on the east coast and the navy yard, Mare Island. The navy yard, Mare Island, is the distributing yard for all points on the west coast and the Asiatic station.

(*d*) Copies of Navy Department Specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department Washington, D. C.

TABLE No. 1

No. 1	No. 2		No. 3	No. 4	No. 5	No. 6
U. S. N. shade	Visible transmittance; per cent visible radiation from source		Radiant energy transmitted; per cent of total above 700 m. u. (maximum)	Radiant energy transmitted; per cent of total between 330 m. u. to 400 m. u. (maximum)	Radiant energy transmitted; per cent of total source (maximum)	Normal uses
	Minimum	Maximum				
8	0.115	0.30	0.90	0.01	1.00	Heavy acetylene welding. Arc cutting and welding 30 to 75 amperes.
10	0.005	0.010	.60	.01	.70	Arc cutting and welding 75 to 200 amperes.
12	0.001	0.004	.475	.005	.50	Arc cutting and welding 200 to 400 amperes.
14	0.0001	0.0005	.20	.0005	.25	Arc cutting and welding 400 amperes and over.

NOTES.—(*a*) Visible transmittance is based on the percentage of the visible radiations of a tungsten lamp operated at normal rating, determined photometrically.

(*b*) Glass shall show not less than 35 per cent of the total energy transmitted in the visible (400 m. u. to 700 m. u.) between wave lengths 525 m. u. and 600 m. u. Maximum peak of the visible energy curve shall fall between these limits. This determination shall be made radiometrically.

(*c*) Glass of shades listed above shall show a radiant energy cut-off not lower than 330 m. u.

(*d*) Radiometric energy determinations are made using as a light source a tungsten incandescent filament lamp, operated at normal commercial rating of temperature as indicated by rated current and voltage.

Class V.—Helmet, Babbitt

This mask or helmet is to furnish protection to the face from splashing and flying molten metal encountered in babbitting, pouring of hot metal, and dipping in hot metal baths, such as galvanizing.

Goggles may be sufficient protection in several pouring operations, and the nature of the work will decide the uses of this helmet, which is primarily for the use of those engaged in pouring babbitt.

In the handling of molten metal care must be taken to eliminate all moisture that might come in contact with the hot molten metal and cause it to fly or splash.

[Navy Department Specifications 37H3, February 1, 1927]

HELMETS, BABBITTING

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at date of opening of bids, shall form part of these specifications.

TYPES

2. The helmet shall be of the steel wire gauze type, equipped with lens mounting and cape or apron.

MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) The materials used in the manufacture and assembly of helmets under these specifications shall be those most suitable for the purpose and such that the helmets can be frequently sterilized, without deterioration, by any of the methods hereinafter covered.

(*b*) Workmanship shall be of the best throughout. The construction shall be sufficiently rugged to withstand rough handling and the service to which the helmets will be subjected. All metal parts shall have a smooth finish, without sharp edges or any irregularities which might cut or scratch the user.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) The helmet shall consist of a shield supported on the head of the wearer and completely protecting the face, neck, side, and top of head to back of the ears, and fitted with adjustable head harness for retaining the helmet comfortably and firmly in place on the head. The helmet shall be constructed of a substantial, steel 40-wire mesh equivalent to United States standard No. 40 standard sieve. The wire gauze shall cover the face down to the chin and have, on its lower edge, a leather or approved cloth apron extending at least 12 inches down to the chest of the wearer. The apron width shall be equal to the maximum width of the helmet. The apron shall be soft and flexible and securely riveted to the gauze. The edges of the gauze shall be beaded with steel wire not less than 0.0475 inch in diameter.*

Babbitting helmet

(*b*) In the front of the helmet shall be fitted two lens mountings designed to accommodate the lenses hereinafter described. The lens mountings shall be so designed that the lenses will be held firmly in place and the removal and replacement of the lenses may be easily accomplished and without damage to the lenses or lens mountings, without the use of tools. The head harness shall be adjustable, to permit setting of the lenses in the line of vision of the wearer.

(*c*) The helmet shall have a permanent black nonreflecting finish.

(*d*) Helmets may be sterilized by either one of the following methods:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.

(*e*) Helmets incapable of withstanding sterilization by either of the above-described methods without deterioration will be rejected.

(*f*) The lenses for helmets shall be solid plate clear glass and shall measure 2.5 inches±$\frac{1}{32}$ inch high, 2.5 inches±$\frac{1}{32}$ inch long, and not less than 0.20 inch thick. The transmission of incident light shall not be less than 90 per cent. Lenses shall be unaffected by sudden changes in temperatures between 40° and 150° F. Lenses shall be made from a grade of glass suitable for optical use and optically finished as to surface. The surfaces shall be free of focus to ⅛ dioptre, and shall be effectively free from prism as judged by image displacement to 5 minutes of arc, at any point on the surface or cumulative over the surface. Glass shall be free from visible or effective striæ, wrinkles, or streaks which would impair the optical qualities of the windows or impair its appearance. Bubbles and pits in the glass, if not farther than ⅜ inch from any edge, and in small number, will be permitted. The edges of the lenses shall be smoothly and uniformly ground. Lenses shall be free from astigmatism.

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) Inspection of helmets shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the helmets comply in all respects with the specifications. If necessary, chemical examination of the helmet materials coming in contact with the skin shall be made to determine whether skin irritants are present.

(*b*) Optical tests for lenses.—Lenses shall be tested for visible striæ, waves, flaws, or any defect which will impair their optical quality, and for focus, prism, and astigmatism, and quality of surface regularity, as indicated by clearness of image viewed through the lens with a 20-power telescope.

(*c*) Lenses shall be tested, without injury, by being heated in water at a temperature of 150° F. for 3 minutes, then plunged into water at a temperature of 40° F.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) Helmets and lenses shall bear some permanent distinctive marking by which the name of the manufacturer may be readily known.

(*b*) Lenses not installed in the helmets shall be individually wrapped in lens paper.

(*c*) Helmets shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure their delivery in undamaged condition.

(*d*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of helmets contained, contract or order number, and the stock number, if this be stated in the contract or order.

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of this apparatus shall be to protect the head, neck, and upper chest of the wearer from flying molten metal, encountered in babbitt pouring and operations of a similar nature.

(*b*) In order to comply with paragraph 6 (*a*), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) Copies of Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

REFERENCES

C. & R. L2/JJ-37H3 (S) N/C, Sept. 2 and Oct. 27, 1926.
Ord. L2-1 (339) (Dm5-5), Sept. 14, 1926.
Aero. Aer-M-157-FAM QB (22), Sept. 23, 1926.
Navy Department Specifications Board, 37H3, Oct. 28, 1926.
S. & A. L2/JJ-37H3.

Class VI.—Respirators, Dust

This type of respirator is to protect the respiratory organs of the wearer from nontoxic dust, powders, and flying particles and can not be used for protection against toxic gases and fumes. Owing to the nature of toxic gases and fumes, the dust respirator affords little or no protection, and, by reason of the false sense of security it gives in such cases, may even result in increased risk to the wearer.

DETAIL REQUIREMENTS

5. (*a*) The helmet shall consist of a shield supported on the head of the wearer and completely protecting the face, neck, side, and top of head to back of the ears, and fitted with adjustable head harness for retaining the helmet comfortably and firmly in place on the head. The helmet shall be constructed of a substantial, steel 40-wire mesh equivalent to United States standard No. 40 standard sieve. The wire gauze shall cover the face down to the chin and have, on its lower edge, a leather or approved cloth apron extending at least 12 inches down to the chest of the wearer. The apron width shall be equal to the maximum width of the helmet. The apron shall be soft and flexible and securely riveted to the gauze. The edges of the gauze shall be beaded with steel wire not less than 0.0475 inch in diameter.

Babbitting helmet

(*b*) In the front of the helmet shall be fitted two lens mountings designed to accommodate the lenses hereinafter described. The lens mountings shall be so designed that the lenses will be held firmly in place and the removal and replacement of the lenses may be easily accomplished and without damage to the lenses or lens mountings, without the use of tools. The head harness shall be adjustable, to permit setting of the lenses in the line of vision of the wearer.

(*c*) The helmet shall have a permanent black nonreflecting finish.

(*d*) Helmets may be sterilized by either one of the following methods:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.

(*e*) Helmets incapable of withstanding sterilization by either of the above-described methods without deterioration will be rejected.

(*f*) The lenses for helmets shall be solid plate clear glass and shall measure 2.5 inches$\pm\frac{1}{32}$ inch high, 2.5 inches$\pm\frac{1}{32}$ inch long, and not less than 0.20 inch thick. The transmission of incident light shall not be less than 90 per cent. Lenses shall be unaffected by sudden changes in temperatures between 40° and 150° F. Lenses shall be made from a grade of glass suitable for optical use and optically finished as to surface. The surfaces shall be free of focus to ⅛ dioptre, and shall be effectively free from prism as judged by image displacement to 5 minutes of arc, at any point on the surface or cumulative over the surface. Glass shall be free from visible or effective striæ, wrinkles, or streaks which would impair the optical qualities of the windows or impair its appearance. Bubbles and pits in the glass, if not farther than ⅜ inch from any edge, and in small number, will be permitted. The edges of the lenses shall be smoothly and uniformly ground. Lenses shall be free from astigmatism.

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) Inspection of helmets shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the helmets comply in all respects with the specifications. If necessary, chemical examination of the helmet materials coming in contact with the skin shall be made to determine whether skin irritants are present.

(*b*) Optical tests for lenses.—Lenses shall be tested for visible striæ, waves, flaws, or any defect which will impair their optical quality, and for focus, prism, and astigmatism, and quality of surface regularity, as indicated by clearness of image viewed through the lens with a 20-power telescope.

(*c*) Lenses shall be tested, without injury, by being heated in water at a temperature of 150° F. for 3 minutes, then plunged into water at a temperature of 40° F.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) Helmets and lenses shall bear some permanent distinctive marking by which the name of the manufacturer may be readily known.

(*b*) Lenses not installed in the helmets shall be individually wrapped in lens paper.

(*c*) Helmets shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure their delivery in undamaged condition.

(*d*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of helmets contained, contract or order number, and the stock number, if this be stated in the contract or order.

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of this apparatus shall be to protect the head, neck, and upper chest of the wearer from flying molten metal, encountered in babbitt pouring and operations of a similar nature.

(*b*) In order to comply with paragraph 6 (*a*), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) Copies of Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

REFERENCES

C. & R. L2/JJ-37H3 (S) N/C, Sept. 2 and Oct. 27, 1926.
Ord. L2-1 (339) (Dm5-5), Sept. 14, 1926.
Aero. Aer-M-157-FAM QB (22), Sept. 23, 1926.
Navy Department Specifications Board. 37H3, Oct. 28, 1926.
S. & A. L2/JJ-37H3.

Class VI.—Respirators, Dust

This type of respirator is to protect the respiratory organs of the wearer from nontoxic dust, powders, and flying particles and can not be used for protection against toxic gases and fumes. Owing to the nature of toxic gases and fumes, the dust respirator affords little or no protection, and, by reason of the false sense of security it gives in such cases, may even result in increased risk to the wearer.

The dust respirator is to protect the organs against such nontoxic dusts and particles as soot, ashes, sawdust, fine powders, etc., as encountered in cleaning operations, scraping, scaling, buffing, polishing, etc.

The use of a sponge as the filter material in a respirator is not permitted, except in such cases where it is used in combination with felt, medicated paper, and cotton filters, where it is desired to saturate the sponge with a deodorant to remove obnoxious odors of a nontoxic nature.

In operations requiring eye protection with the respirator, rubber goggles, specifications 37-G-5 should be used.

[Navy Department Specifications 37R1, February 1, 1927]

Respirators, Dust

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at date of opening of bids, shall form part of these specifications.

TYPE

2. Respirator shall be of a type that will protect the respiratory organs of the wearer from nontoxic dust and light flying particles. (Apparatus for protection of the respiratory organs from toxic gas and dust is covered in separate specifications.)

MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) Materials used in the manufacture and assembly of respirators shall be those most suitable for the purpose. The materials shall be such that the respirators can be frequently sterilized, without deterioration, by the methods hereinafter covered.

(*b*) The metals used shall be corrosion resisting. Materials shall be nonirritating to the skin when subjected to perspiration.

(*c*) The rubber used in the construction of the respirators shall be of lasting quality, vulcanized, nonblooming, and free from lead and mineral sulphates.

(*d*) The materials used shall be such as to combine mechanical strength and lightness of weight.

(*e*) Workmanship shall be of the best throughout. All metal parts shall have a smooth finish, without sharp edges or any irregularities which might cut or scratch the user. The construction shall be sufficiently rugged to withstand rough handling and the service to which it will be subjected.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) The respirator shall consist of a body completely covering the nostrils and mouth of the wearer and fitted with an elastic, adjustable head band for retaining the respirator comfortably and tightly over the nose and mouth.

(*b*) Head bands may be either cotton elastic webbing having a minimum width of ⅞ inch, or solid rubber type, made of the proper grade rubber, having a minimum width of ¾ inch.

(*c*) The body shall be of rubber or other approved material and shall embody a metal dust filter compartment and a disk relief valve. The filter compartment and cover shall be such as to hold a suitable wire mesh and filter in proper place.

(*d*) The filter material shall be felt, cotton, or medicated paper of proper thickness. Filters shall be held securely in the filter compartment and be easily removable and replaceable without damage to the respirator. The filter material shall exclude all dust and permit easy breathing by the wearer.

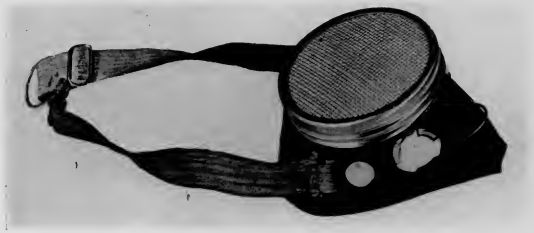
(*e*) The relief valve shall prevent the entrance of any air through it upon inhalation by the wearer and shall permit the free egress of air upon exhalation.

(*f*) The facial contact edge of the respirator body shall be a suitable soft rubber cushion which shall form a dust-tight contact with the face. The respirator, when in place on the wearer, shall be dust-tight and permit the use of the various types of goggles without impairing the effectiveness of either the goggles or the respirator.

(*g*) Respirators may be sterilized by either of the following methods:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.



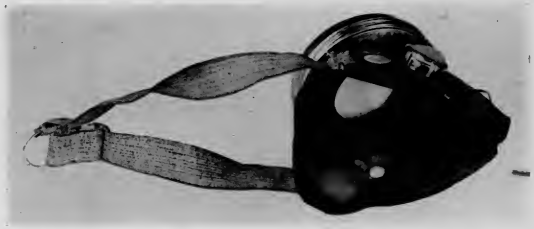
Dust respirator, front assembly

(*h*) Respirators incapable of withstanding sterilization by either of the above-described methods without deterioration will be rejected.

(*i*) Respirators shall bear a permanent distinctive marking indicating name of manufacturer.

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) Inspection of respirators shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the respirators comply, in all respects, with the specifications. If necessary, chemical examination of respirator materials coming in contact with the skin shall be made to determine whether skin irritants are present.



Dust respirator, back assembly

(*b*) The contractor shall furnish, in connection with the matter of inspection and tests, evidence indicating that the materials of which the respirators were made are free from skin irritants.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) Respirators shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure delivery of material in undamaged condition.

(*b*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of respirators contained, number of contract or order, and the stock number, if this be stated in the contract or order.

The dust respirator is to protect the organs against such nontoxic dusts and particles as soot, ashes, sawdust, fine powders, etc., as encountered in cleaning operations, scraping, scaling, buffing, polishing, etc.

The use of a sponge as the filter material in a respirator is not permitted, except in such cases where it is used in combination with felt, medicated paper, and cotton filters, where it is desired to saturate the sponge with a deodorant to remove obnoxious odors of a nontoxic nature.

In operations requiring eye protection with the respirator, rubber goggles, specifications 37–G–5 should be used.

[Navy Department Specifications 37R1, February 1, 1927]

Respirators, Dust

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at date of opening of bids, shall form part of these specifications.

TYPE

2. Respirator shall be of a type that will protect the respiratory organs of the wearer from nontoxic dust and light flying particles. (Apparatus for protection of the respiratory organs from toxic gas and dust is covered in separate specifications.)

MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) Materials used in the manufacture and assembly of respirators shall be those most suitable for the purpose. The materials shall be such that the respirators can be frequently sterilized, without deterioration, by the methods hereinafter covered.

(*b*) The metals used shall be corrosion resisting. Materials shall be nonirritating to the skin when subjected to perspiration.

(*c*) The rubber used in the construction of the respirators shall be of lasting quality, vulcanized, nonblooming, and free from lead and mineral sulphates.

(*d*) The materials used shall be such as to combine mechanical strength and lightness of weight.

(*e*) Workmanship shall be of the best throughout. All metal parts shall have a smooth finish, without sharp edges or any irregularities which might cut or scratch the user. The construction shall be sufficiently rugged to withstand rough handling and the service to which it will be subjected.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) The respirator shall consist of a body completely covering the nostrils and mouth of the wearer and fitted with an elastic, adjustable head band for retaining the respirator comfortably and tightly over the nose and mouth.

(*b*) Head bands may be either cotton elastic webbing having a minimum width of ⅞ inch, or solid rubber type, made of the proper grade rubber, having a minimum width of ¾ inch.

(*c*) The body shall be of rubber or other approved material and shall embody a metal dust filter compartment and a disk relief valve. The filter compartment and cover shall be such as to hold a suitable wire mesh and filter in proper place.

(*d*) The filter material shall be felt, cotton, or medicated paper of proper thickness. Filters shall be held securely in the filter compartment and be easily removable and replaceable without damage to the respirator. The filter material shall exclude all dust and permit easy breathing by the wearer.

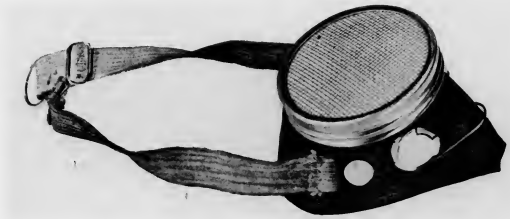
(*e*) The relief valve shall prevent the entrance of any air through it upon inhalation by the wearer and shall permit the free egress of air upon exhalation.

(*f*) The facial contact edge of the respirator body shall be a suitable soft rubber cushion which shall form a dust-tight contact with the face. The respirator, when in place on the wearer, shall be dust-tight and permit the use of the various types of goggles without impairing the effectiveness of either the goggles or the respirator.

(*g*) Respirators may be sterilized by either of the following methods:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.



Dust respirator, front assembly

(*h*) Respirators incapable of withstanding sterilization by either of the above-described methods without deterioration will be rejected.

(*i*) Respirators shall bear a permanent distinctive marking indicating name of manufacturer.

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) Inspection of respirators shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the respirators comply, in all respects, with the specifications. If necessary, chemical examination of respirator materials coming in contact with the skin shall be made to determine whether skin irritants are present.

Dust respirator, back assembly

(*b*) The contractor shall furnish, in connection with the matter of inspection and tests, evidence indicating that the materials of which the respirators were made are free from skin irritants.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) Respirators shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure delivery of material in undamaged condition.

(*b*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of respirators contained, number of contract or order, and the stock number, if this be stated in the contract or order.

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of these respirators shall be to protect the respiratory organs of the wearer from nontoxic dust and light flying particles.

(*b*) In order to comply with paragraph 6 (*a*), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) Copies of Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

Dust-respirator parts

REFERENCES

C. & R. L2/JJ-37R1 (S) N/C, Sept. 2 and Oct. 27, 1926.
Eng. JJ-37R1 (9-4-Ds), Sept. 9, 1926.
Ord. L2-1(342) (Dm5-5), Sept. 14, 1926.
Y. & D. JJ-37R1, Sept. 16. 1926.
Aero. Aer-M-157-FAM QB(22), Sept. 23, 1926.
Navy Department Specifications Board, 37R1, Oct. 28, 1926.
S. & A. L2/JJ-37R1.

Class VII.—Helmets, Sand-Blasting

These helmets, of the external air-supply type, are primarily for sand-blasting operators where protection is desired against an excessive amount of dust and small flying particles.

Where necessary, an air separator shall be used on the line, in order to insure supplying the air to the helmet free from dirt, oil, and water. This separator may be obtained by request upon the navy yard, New York.

[Navy Department Specifications 37115, February 1, 1927]

HELMETS, SAND-BLASTING

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at date of opening of bids, shall form part of these specifications.

TYPE

2. Helmets shall be of the type for use with external air supply.

MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) The materials used in the manufacture and assembly of helmets under these sepcifications shall be those most suitable for the purpose and such that they can be frequently sterilized without deterioration by any of the methods hereinafter covered.

(*b*) Workmanship shall be of the best throughout. All parts shall be finished smooth and without sharp edges or irregularities that might cut or scratch the wearer. All sewing shall be done with a heavy linen thread and with a lock stitch. The construction shall be sufficiently rugged to withstand rough handling and the service to which it will be subjected.

(*c*) Material may be undyed, or dyed with fast colors, and shall be nonirritating to the skin.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) The helmet shall consist of a shield supported by the head of the wearer, completely protecting the head, and provided with a skirt to protect the neck and shoulders. This skirt shall be tailored to the shoulders and be of sufficient length to fit under the clothes of the wearer.

(*b*) The helmet shall be fitted with a nonelastic adjustable head harness so that it will be retained comfortably and firmly in place on the head.

(*c*) The helmet shall be constructed of light chrome leather or approved closely woven canvas, and the crown shall be sufficiently strong or reinforced to retain its original shape.

(*d*) The design of the helmet shall be such that it shall be supported by stays or other effective means so that there shall be ample space between all parts of the helmet and the head of the wearer.

(*e*) The top of the helmet shall be fitted with a suitable connection to accommodate and hold securely by wire wrapping or hose clamp the end of a compressed air hose. Air shall enter the helmet through this connection and be carried by suitable tubing inside the helmet to a specially designed window frame for distribution over the glass as specified herein. A belt of canvas, not less than 1½ inches wide, of strong construction and with suitable buckle, shall be provided, fitted with a retainer for the air hose, to relieve the helmet of the weight of the hose.

(*f*) In the front of the helmet shall be fitted a suitable window consisting of a rigid frame built to accommodate a glass window 2⅜ inches high by 4¾ inches long, actual visual area, so held as to permit the use of a copper protecting gauge outside the glass if desired. The glass shall be so set in this frame as to be easily removable for replacement and shall be seated inside on felt or other suitable material to prevent the entrance of dust around the lens. The upper part of the window frame shall be designed

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of these respirators shall be to protect the respiratory organs of the wearer from nontoxic dust and light flying particles.

(*b*) In order to comply with paragraph 6 (*a*), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*c*) Copies of Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

Dust-respirator parts

REFERENCES

C. & R. L2/JJ-37R1 (S) N/C, Sept. 2 and Oct. 27, 1926.
Eng. JJ-37R1 (9-4-Ds), Sept. 9, 1926.
Ord. L2-1(342) (Dm5-5), Sept. 14, 1926.
Y. & D. JJ-37R1, Sept. 16, 1926.
Aero. Aer-M-157-FAM QB(22), Sept. 23, 1926.
Navy Department Specifications Board, 37R1, Oct. 28, 1926.
S. & A. L2/JJ-37R1.

Class VII.—Helmets, Sand-Blasting

These helmets, of the external air-supply type, are primarily for sand-blasting operators where protection is desired against an excessive amount of dust and small flying particles.

Where necessary, an air separator shall be used on the line, in order to insure supplying the air to the helmet free from dirt, oil, and water. This separator may be obtained by request upon the navy yard, New York.

[Navy Department Specifications 37115, February 1, 1927]

HELMETS, SAND-BLASTING

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at date of opening of bids, shall form part of these specifications.

TYPE

2. Helmets shall be of the type for use with external air supply.

MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) The materials used in the manufacture and assembly of helmets under these sepcifications shall be those most suitable for the purpose and such that they can be frequently sterilized without deterioration by any of the methods hereinafter covered.

(*b*) Workmanship shall be of the best throughout. All parts shall be finished smooth and without sharp edges or irregularities that might cut or scratch the wearer. All sewing shall be done with a heavy linen thread and with a lock stitch. The construction shall be sufficiently rugged to withstand rough handling and the service to which it will be subjected.

(*c*) Material may be undyed, or dyed with fast colors, and shall be nonirritating to the skin.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) The helmet shall consist of a shield supported by the head of the wearer, completely protecting the head, and provided with a skirt to protect the neck and shoulders. This skirt shall be tailored to the shoulders and be of sufficient length to fit under the clothes of the wearer.

(*b*) The helmet shall be fitted with a nonelastic adjustable head harness so that it will be retained comfortably and firmly in place on the head.

(*c*) The helmet shall be constructed of light chrome leather or approved closely woven canvas, and the crown shall be sufficiently strong or reinforced to retain its original shape.

(*d*) The design of the helmet shall be such that it shall be supported by stays or other effective means so that there shall be ample space between all parts of the helmet and the head of the wearer.

(*e*) The top of the helmet shall be fitted with a suitable connection to accommodate and hold securely by wire wrapping or hose clamp the end of a compressed air hose. Air shall enter the helmet through this connection and be carried by suitable tubing inside the helmet to a specially designed window frame for distribution over the glass as specified herein. A belt of canvas, not less than 1½ inches wide, of strong construction and with suitable buckle, shall be provided, fitted with a retainer for the air hose, to relieve the helmet of the weight of the hose.

(*f*) In the front of the helmet shall be fitted a suitable window consisting of a rigid frame built to accommodate a glass window 2⅜ inches high by 4¾ inches long, actual visual area, so held as to permit the use of a copper protecting gauge outside the glass if desired. The glass shall be so set in this frame as to be easily removable for replacement and shall be seated inside on felt or other suitable material to prevent the entrance of dust around the lens. The upper part of the window frame shall be designed

as an air duct and shall be arranged to pass a curtain of air over both the inside and outside surface of the lens, this curtain of air passing at high velocity and of sufficient volume to prevent settling of dust outside the lens and prevent fogging of the lens inside. The volume of air emitted over the inside surface shall be sufficient to supply air for breathing and shall exhaust inside the hood. The air on the inside glass surface shall

Sand-blast helmet

be so directed that it does not blow into the face of the operator. The air shall be conducted to the window frame from the connection in the top of the hood by a tube. No air shall enter the hood except through the ducts as described above. The exhaust of air from the hood shall be only by natural leakage through the bottom of the hood over the shoulders of the operator. The window frame shall be ruggedly constructed

of heavy sheet metal or casting of brass or aluminum alloy, or such other material as is specified. The window frame shall be so secured as to prevent entrance of dust, and in such a manner as to give maximum wear.

(*g*) A suitable draw strap shall be fitted to the helmet to secure same to the shoulders.

(*h*) All parts of the helmet, except the seams of the shield, shall be securely held by riveting.

(*i*) The head harness shall be adjustable to permit the setting of the window in the line of vision of the wearer.

(*j*) Helmet shall furnish suitable and safe respiratory protection against dust.

(*k*) Helmets may be sterilized by either of the following methods:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(2) Subjection to sterilization by a moist atmosphere of antisepetic gas, preferably formaldehyde, for a period of 10 minutes.

(*l*) Helmets incapable of withstanding sterilization by either of the above-described methods without deterioration will be rejected.

(*m*) The size of air hose for use with helmet shall be $\frac{5}{16}$ inch $\pm$ $\frac{1}{64}$ inch inside diameter, $\frac{5}{8}$ inch $\pm$ $\frac{1}{32}$ inch outside diameter, and when supplied with helmets it shall comply with issue of Navy Department specifications 34H8 in effect at date of opening of bids.

(*n*) Lenses for helmets shall be of the single type 2.375 inches $\pm$ 0.10 inch high by 4.75 inches $\pm$ 0.10 inch long and 0.10 inch think. Lenses shall be made from a grade of glass suitable for optical use and optically finished as to surface. The transmission of incident light shall not be less than 90 per cent. The surfaces shall be free of focus to one-eighth dioptro, and shall be effectively free from prism, as judged by image displacement, to five minutes of arc at any point on the surface, or cumulative over the surface. Glass shall be free from visible or effective striae, wrinkles, or streaks which would impair the optical qualities of the window, or impair its appearance. Bubbles and pits in the glass, if not farther than $\frac{3}{8}$ inch from any edge and in small number, are permitted. The edges of the lenses shall be smoothly and uniformly ground. Lenses shall be free from astigmatism.

(*o*) The cover screens for lenses shall consist of a 100 square mesh copper gauze of approximately 0.004 inch diameter wire.

(*p*) Fastness of dyed material shall be such that after boiling in clear water for five minutes, the water shall remain clear.

(*q*) Sand-blasting helmets shall be completely dust-tight.

METHOD OF INSPECTION, TEST, ETC.

6. (*a*) The inspection of helmets shall be made at the navy yard, Brooklyn, N. Y. Visual examination and such physical, chemical, and performance tests shall be made as the inspector may deem necessary to ascertain whether the helmets are satisfactory and comply with the specifications.

(*b*) The contractor shall furnish evidence indicating that the material is free from skin irritants.

(*c*) All lenses shall be tested for visual striae, waves, flaws, or any defect which would impair their optical quality, for focus, prism, and astigmatism, and quality of surface regularity as indicated by clearness of image viewed through the lens with a 20-power telescope.

PACKING AND MARKING OF SHIPMENTS

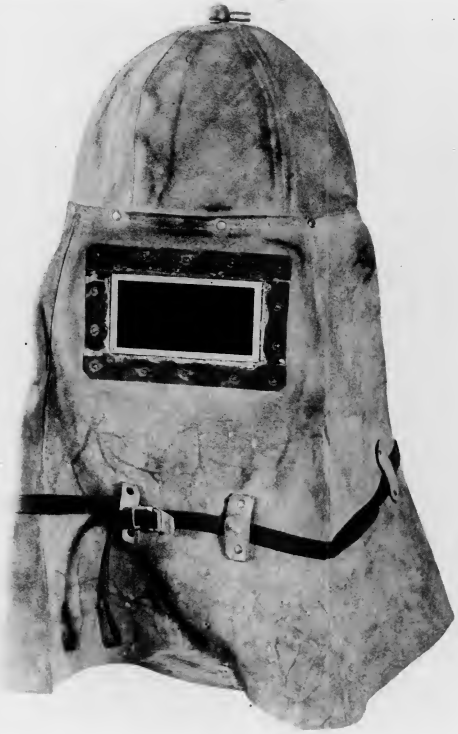
7. (*a*) Helmets and lenses shall bear some permanent distinctive marking indicating name of manufacturer.

(*b*) Lenses not installed in the helmet shall be individually wrapped in lens paper.

(*c*) Helmets shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure the delivery of material in undamaged condition.

(*d*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of helmets contained, number of contract or order and the stock number, if this be stated in the contract or order.

as an air duct and shall be arranged to pass a curtain of air over both the inside and outside surface of the lens, this curtain of air passing at high velocity and of sufficient volume to prevent settling of dust outside the lens and prevent fogging of the lens inside. The volume of air emitted over the inside surface shall be sufficient to supply air for breathing and shall exhaust inside the hood. The air on the inside glass surface shall



Sand-blast helmet

be so directed that it does not blow into the face of the operator. The air shall be conducted to the window frame from the connection in the top of the hood by a tube. No air shall enter the hood except through the ducts as described above. The exhaust of air from the hood shall be only by natural leakage through the bottom of the hood over the shoulders of the operator. The window frame shall be ruggedly constructed

of heavy sheet metal or casting of brass or aluminum alloy, or such other material as is specified. The window frame shall be so secured as to prevent entrance of dust, and in such a manner as to give maximum wear.

(*g*) A suitable draw strap shall be fitted to the helmet to secure same to the shoulders.

(*h*) All parts of the helmet, except the seams of the shield, shall be securely held by riveting.

(*i*) The head harness shall be adjustable to permit the setting of the window in the line of vision of the wearer.

(*j*) Helmet shall furnish suitable and safe respiratory protection against dust.

(*k*) Helmets may be sterilized by either of the following methods:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

(2) Subjection to sterilization by a moist atmosphere of antisepetic gas, preferably formaldehyde, for a period of 10 minutes.

(*l*) Helmets incapable of withstanding sterilization by either of the above-described methods without deterioration will be rejected.

(*m*) The size of air hose for use with helmet shall be $\frac{5}{16}$ inch $\pm$ $\frac{1}{64}$ inch inside diameter, $\frac{5}{8}$ inch $\pm$ $\frac{1}{32}$ inch outside diameter, and when supplied with helmets it shall comply with issue of Navy Department specifications 34HS in effect at date of opening of bids.

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(*o*) The cover screens for lenses shall consist of a 100 square mesh copper gauze of approximately 0.004 inch diameter wire.

(*p*) Fastness of dyed material shall be such that after boiling in clear water for five minutes, the water shall remain clear.

(*q*) Sand-blasting helmets shall be completely dust-tight.

METHOD OF INSPECTION, TEST, ETC.

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7. (*a*) Helmets and lenses shall bear some permanent distinctive marking indicating name of manufacturer.

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(*d*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of helmets contained, number of contract or order and the stock number, if this be stated in the contract or order.

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of this apparatus shall be to protect the head, neck, shoulders, and respiratory organs of operators performing sand blasting or similar operations.

(*b*) In order to comply with paragraph 6(*a*) all material furnished under these specifications should be delivered to navy yard, Brooklyn, N. Y.

(*c*) Copies of Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

Class VIII.—Respirator, Paint Spray

The respirator of this class on type is primarily for the use of painters and those engaged in paint spraying. The chemical absorbent and filters, with which the respirator is equipped, furnishes protection to the respiratory organs from spray, mist, and particles of paint and pigments, and the gases and fumes of paint solvents.

When resistance to breathing is noticed, the filters should be changed and the chemical absorbent changed whenever odors or gases are detected by the wearer. Under severe working conditions the filters should be changed every four hours and the chemical absorbent every eight hours.

These respirators offer protection from toxic gases in a limited field. Where sulphur dioxide, acid fumes, and such gases are present and not in excessive amount, this respirator may be used, but a layer of caustic pumice or soda lime is to be inserted with the activated charcoal or chemical absorbent. A wire gauze and filter should be inserted between these two layers. Owing to the small capacity of the chemical container, the respirators should be frequently inspected and changed when required. Appearance of fumes in the respirator while in use is an indication of a saturated filter.

These respirators equipped with the two layers of chemicals as described above can be used when severe conditions are met with in the galvanizing plant, where acid fumes from the pickling tanks and zinc oxide and fumes are present because of the molten zinc and use of the sal ammoniac flux. The galvanizing plant should be well ventilated and respirators of this type supplied to the workers in this department.

[Navy Department Specifications, March 28, 1927]

RESPIRATOR, PAINT SPRAYING

GENERAL SPECIFICATIONS

1. General Specifications for Inspection of Material, issued by the Navy Department, in effect at date of opening of bids, shall form part of these specifications.

TYPE

2. The respirator shall be of a type equipped with a filter compartment containing chemical absorbent and filters that will protect the respiratory organs of the wearer from fumes, gases, liquids, and solids encountered in paint spraying.

MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) Materials used in the manufacture and assembly of respirators shall be new, unused, of enduring quality, and those most suitable for the purpose. The materials shall be such that the respirators can be frequently sterilized, without deterioration, by the methods hereinafter covered.

(*b*) The metals used shall be corrosion resisting. Materials shall be nonirritating to the skin when subjected to perspiration.

(*c*) The rubber used in the construction of the respirators shall be of lasting quality, vulcanized, nonblooming, and free from lead and mineral sulphates.

(*d*) The materials used shall be such as to combine mechanical strength and lightness of weight.

(*e*) Workmanship shall be of the best throughout. All metal parts shall have a smooth finish, without sharp edges or any irregularities which might

Respirator with built-in compartment for bulk filling, front assembly

cut or scratch the user. The construction shall be sufficiently rugged to withstand rough handling and the service to which it will be subjected.

GENERAL REQUIREMENTS

4. See paragraph 5.

DETAIL REQUIREMENTS

5. (*a*) The respirator shall consist of a body completely covering the nostrils and mouth of the wearer and be fitted with an elastic, adjustable head band or bands for retaining the respirator comfortably and tightly over the nose and mouth.

Respirator with built-in compartment for bulk filling, back assembly

(*b*) Head bands may be either cotton elastic webbing having a minimum width of ⅞ inch, or solid rubber type, made of the proper grade rubber, having a minimum width of ¾ inch.

(*c*) The body shall be of rubber or other approved material and shall embody a metal filter compartment and a disk relief valve or other approved type. The filter compartment and cover shall be such as to secure in proper place sufficient quantity of chemical absorbent, suitable wire mesh and filters.

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of this apparatus shall be to protect the head, neck, shoulders, and respiratory organs of operators performing sand blasting or similar operations.

(*b*) In order to comply with paragraph 6(*a*) all material furnished under these specifications should be delivered to navy yard, Brooklyn, N. Y.

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MATERIAL AND WORKMANSHIP, ETC.

3. (*a*) Materials used in the manufacture and assembly of respirators shall be new, unused, of enduring quality, and those most suitable for the purpose. The materials shall be such that the respirators can be frequently sterilized, without deterioration, by the methods hereinafter covered.

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(*c*) The rubber used in the construction of the respirators shall be of lasting quality, vulcanized, nonblooming, and free from lead and mineral sulphates.

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Respirator with built-in compartment for bulk filling, front assembly

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DETAIL REQUIREMENTS

5. (*a*) The respirator shall consist of a body completely covering the nostrils and mouth of the wearer and be fitted with an elastic, adjustable head band or bands for retaining the respirator comfortably and tightly over the nose and mouth.

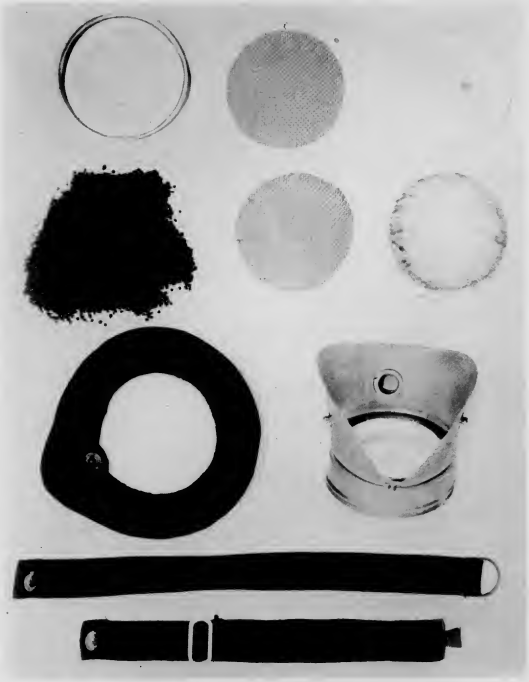
Respirator with built-in compartment for bulk filling, back assembly

(*b*) Head bands may be either cotton elastic webbing having a minimum width of ⅞ inch, or solid rubber type, made of the proper grade rubber, having a minimum width of ¾ inch.

(*c*) The body shall be of rubber or other approved material and shall embody a metal filter compartment and a disk relief valve or other approved type. The filter compartment and cover shall be such as to secure in proper place sufficient quantity of chemical absorbent, suitable wire mesh and filters.

(*d*) The chemical absorbent shall be activated charcoal, possessing the necessary hardness and activity for successful use as an absorbent of gases, and shall be nominally 6–14 mesh and have the following distribution of sizes:

Retained on 6 mesh: Not more than 4 per cent by weight.
Passing 6 mesh, retained on 8 mesh: Not more than 38 per cent by weight.
Passing 8 mesh, retained on 10 mesh: Not more than 37 per cent by weight.
Passing 10 mesh, retained on 14 mesh: Not more than 14 per cent by weight.
Passing 14 mesh: Not more than 7 per cent by weight.



Respirator with built-in compartment for bulk filling, parts

(*e*) The filter material shall be felt, cotton, or medicated paper of proper thickness. Filters and absorbent material shall be securely retained in the filter compartment and be easily removable and replaceable without damage to the respirator. The filter material and chemical absorbent shall exclude all mist, spray, fumes and gases from paint, and its solvents, such as benzol, turpentine, anyl acetate, oils, etc., and permit easy breathing by the wearer.

(*f*) The relief valve shall be such as to permit the free egress of air upon exhalation and to prevent the entrance of any air upon inhalation. There shall be no exhalation through the filter compartment.

(*g*) The facial contact edge of the respirator body shall be a suitable soft or sponge rubber cushion, which shall form a gas-tight contact with the face. The respirator, when in place on the wearer, shall not interfere with vision or lessen the effectiveness of goggles when worn with respirator.

(*h*) Respirators may be sterilized by either of the following methods:

(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

Respirator with renewable cartridge, front assembly

(2) Subjection to sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 minutes.

(*i*) Respirators incapable of withstanding sterilization by either of the above-described methods without deterioration will be rejected.

(*j*) Respirators shall be supplied with the filter compartment, fitted with suitable filters and sufficient chemical absorbent, or without these items, as is specified.

(*k*) Respirators shall bear a permanent distinctive marking indicating the name of the manufacturer.

Respirator with renewable cartridge, back assembly

METHOD OF INSPECTION, TESTS, ETC.

6. (*a*) Inspection of respirators shall be made at the navy yard, Brooklyn, N. Y. Visual examination and physical tests shall be conducted to ascertain whether the respirators comply, in all respects, with the specifications. If necessary, chemical examination of respirator materials coming in contact with the skin shall be made to determine whether skin irritants are present.

(*b*) The contractor shall furnish, in connection with the matter of inspection and tests, evidence indicating that the materials of which the respirators were made are free from skin irritants.

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Respirator with built-in compartment for bulk filling, parts

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(1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water.

Respirator with renewable cartridge, front assembly

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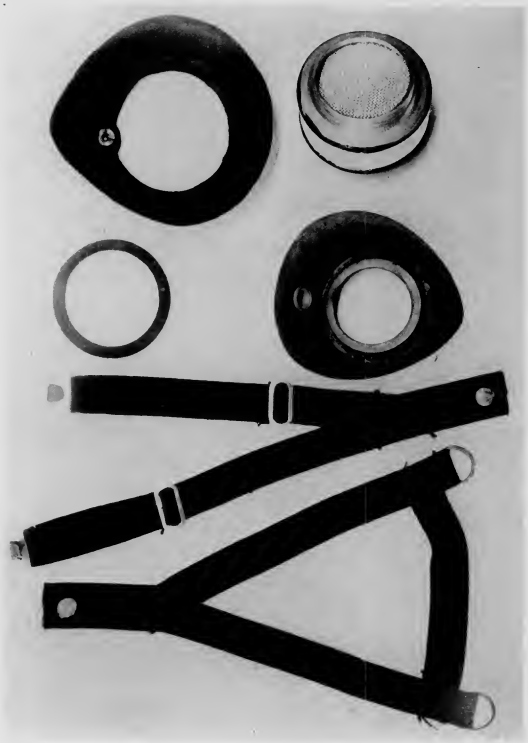
(*b*) The contractor shall furnish, in connection with the matter of inspection and tests, evidence indicating that the materials of which the respirators were made are free from skin irritants.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) Respirators shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure delivery of material in undamaged condition.

(*b*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of respirators contained, number of contract or order, and the stock number, if this be stated in the contract or order.



Respirator with renewable cartridge, parts

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of these respirators shall be to protect the respiratory organs of the wearer from spray, mist, fumes, and gases from paint and paint solvents.

(*b*) Requisitions should specify whether filter compartment of respirators shall be fitted with filters and chemical absorbent. (See paragraph 5 (*j*).)

(*c*) In order to comply with paragraph 6 (*a*), all material furnished under these specifications should be delivered to the navy yard, Brooklyn, N. Y.

(*d*) Copies of Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

Class IX.—Protectors for Respiratory Organs of Welders and Cutters in Ship Breaking and Presence of Lead Fume

Prevention of the inhalation of the poisonous lead fume, which is liberated at the high temperature of the welding and cutting flame as it comes in contact with lead-painted surfaces or with red lead, requires protectors with an external air supply. The nature of this fume is such that it can be completely held back only by a layer of cotton wool 6 inches thick. Therefore, respirators and such means as to filter the fume can not be used.

One type of protector that may be used is the sandblaster's helmet, equipped with suitable cover and filter lenses in a hinged frame, in addition to the clear lens or window of the helmet. The cover and filter lenses, in hinged frame, can be quickly removed to permit a clear vision without removal of the helmet and no danger of inhaling the fume.

Another type of protector is a hood made of closely woven canvas, completely covering the head and shoulders. This hood is equipped with a metal frame, for the necessary cover and filter lenses, and suitable head harness. The lens frame is designed to be attached to the air line and supply air inside the hood and also permit a current of air on the outside to be directed at the work, and keep the fume away from the welder.

In both of the above types of protectors, care should be taken that the supply of air and the pressure is such that no air will enter through the bottom of the helmet or hood.

Another means of protection against lead fume is the hose mask later described, used with a welder's helmet or shield, or with the eyepieces provided with suitable clips to hold filter and cover lenses.

The sandblaster's helmet and the hose mask are standard equipment and can be obtained through the navy yard, New York. A canvas hood, of the type described, was designed and made at the Boston yard and has been used successfully. In the case of a yard manufacturing a hood or protector for this purpose, it must be submitted to the department for approval before being used.

Class X.—Hose Masks

The hose mask is for the protection of the respiratory organs against toxic gases, dusts, and fumes, and also for use in close and confined apartments where there is a deficiency of oxygen.

Each face mask is equipped with 50 feet of hose; 50 feet being the limit of free-air supply for hose 7/8-inch inside diameter.

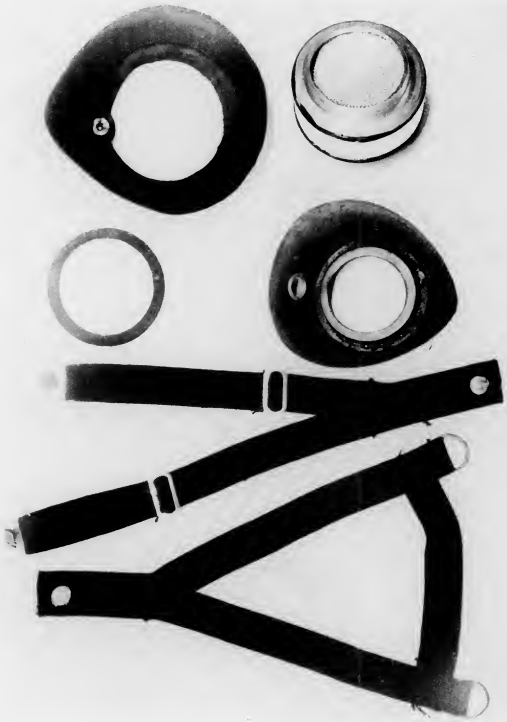
The mask can be equipped with a special ammonia cannister for use in the repair and overhaul of ice machines, where there is a hazard from ammonia fumes. These cannisters may be obtained through the navy yard, New York.

The mask may be attached to the air line, but in such cases if necessary, an air separator should be used to separate dirt, oil, and free water from the air supplied from the compressed-air system.

PACKING AND MARKING OF SHIPMENTS

7. (*a*) Respirators shall be packed in suitable packing cases or containers of sufficiently rugged construction to insure delivery of material in undamaged condition.

(*b*) Packing cases or containers shall be marked on the outside to indicate contents, name of contractor, number of respirators contained, number of contract or order, and the stock number, if this be stated in the contract or order.



Respirator with renewable cartridge, parts

NOTES TO SUPPLY OFFICERS, BIDDERS, MANUFACTURERS, AND OTHERS

8. (*a*) The general function of these respirators shall be to protect the respiratory organs of the wearer from spray, mist, fumes, and gases from paint and paint solvents.

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The mask can be equipped with a special ammonia cannister for use in the repair and overhaul of ice machines, where there is a hazard from ammonia fumes. These cannisters may be obtained through the navy yard, New York.

The mask may be attached to the air line, but in such cases if necessary, an air separator should be used to separate dirt, oil, and free water from the air supplied from the compressed-air system.

This mask is similar to the Army gas mask. As the specifications are rather long, in order to cover in detail every part and all materials of construction, they are not given as part of this code, and the reader is referred to the Navy specifications for hose masks for navy-yard use.

Section III.—DISCUSSION

The material laboratory of the navy yard, New York, is the inspection and testing center for the Navy for all safety apparatus for head, eyes, and respiratory organs protection. The latest and special equipment for this purpose has been installed there. As the purchasing yard and distributing point for material of this nature, a sufficient stock is carried at the navy yard, New York, in order to supply standard safety apparatus without delay to all naval industrial activities.

Optical qualities of lenses.

The optical qualities of all lenses are carefully tested in order that they will not impair or injure the vision in any way. While affording protection from the industrial hazard, the lenses of goggles, helmets, and shields must also protect the wearer against eye strain and therefore the lenses should be optically neutral. The lenses should act as though they were nonexistent, except as a protective medium against chips, dust, liquids, and dangerous radiations.

One method of test used by the Navy for inspecting the optical qualities of lenses, illustrates the quality of a lens being optically. A low-powered telescope is mounted and focused on a brightly illuminated target. When a lens that is optically neutral is placed in front of the objective of the telescope, there is no change in the clear-cut image of the target as viewed through the telescope.

The refusal of many workmen in eye-hazardous occupations to wear goggles for any length of time and complaining that the goggles "draw the eyes" may have had some foundation in the past and was not all due to the imagination. All the lenses of safety apparatus that comply with Navy specifications and are issued to the Navy workmen are free from optical defects that will "draw the eyes" or cause eye strain. The colored filter lenses for the welders' goggles are carefully matched and supplied in pairs, in order that there will be no eye discomfort due to a variance in shades between the two lenses.

The physical test of lenses for resistance to mechanical shock and impact is accomplished by means of the "ball test," which is fully described in the specification for chippers goggles. Lenses that shatter and explode upon breakage are not accepted by the Navy.

Intense visible light and harmful radiant energy.

Filter lenses, for the protection of the eyes against intense visible light and harmful radiant energy, must be selected with care and by persons qualified to do so. Judgment by shade and density is no basis for selecting different makes or types of lenses.

In filter lenses, we are dealing with light and heat. Some knowledge of the theory of light and heat is necessary in order to appreciate the functions a good filter lens must perform.

Light is radiant energy propagated in the form of waves in the ether, and heat likewise is a manifestation of energy in radiant form. The visible spectrum which consists of the colored band of violet, blue, yellow, green, orange, and red which is formed when white or ordinary light is passed through a glass prism, does not tell the whole story. White light is a blend of the above visible wave lengths or colors, the violet being the shortest and increasing in length to the red, which is the longest wave length. These rays or wave lengths merge one into the other without any definite boundary lines. This is the visible part of the spectrum or the wave lengths to which the eye is susceptible. We now come to the invisible sides of the spectrum. On the violet side we have still shorter wave lengths known as the ultra-violet rays and on the red side still longer wave lengths known as the infra-red rays, both of which are invisible but exert pathologic effects. In protecting the eyes we now have to consider: Invisible ultra-violet rays, visible light rays, and invisible infra-red rays.

The pathologic effect of ultra-violet radiant energy upon the animal tissue has long been known. Even slight exposure of the eyes to a source rich in ultra-violet vibrations, such as the carbon and metal arcs, may seriously injure the eyes, and cause temporary or even permanent blindness. When the intensity is high, the skin as well as the eye is affected by ultra-violet radiant energy. In arc welding protection to the skin as well as the eyes is necessary, and this is accomplished by using a helmet or hand shield.

The invisible infra-red rays are primarily heat rays. Their action is to dry out or burn the eyes through the absorption of an excessive amount of heat energy by the tissues and humors of the eye. Cataracts are believed to be caused by these rays. Glass blowers whose eyes are subjected to intense heat often suffer from cataracts.

Excessive brightness must also be avoided and guarded against. The visible light must be moderated in intensity so as not to injure or tire the eyes.

Most sources of light emit mixed radiations, and light waves varying in length are present. Some sources are richer in certain wave lengths than others, as for example the electric arc being rich in ultra-violet and the molten mass of glass with which the glass blower works being rich in infra-red.

When light of different wave lengths is mixed together the eye sums up the effect of the visible portion. Measurements of the intensity of the visible are made by means of the photometer, in which this intensity is compared by the eye with the intensity of the light from a standard source.

For the portion of the radiant energy which is not visible, as the ultra-violet and infra-red, other means must be used. Since when light is absorbed its energy may be entirely converted into heat, one of the most simple methods of measuring radiant energy, whether visible or not visible, is by means of a thermopile. By use of the thermopile the absorbed light produces heat and this heat in turn produces a measurable electric current. The thermopile can be used to measure the total energy, or if the radiation is analyzed in a spectrum, the energy of each particular wave length can be measured independently.

A filter lens is something more than just a piece of colored glass. In the Navy specifications the shades or densities have been standardized, the dangerous ultra-violet and infra-red rays excluded to within safe limits, and the useful colors or visible portion of the spectrum, so modified as to give a clear vision. A uniform product of proven safety value is now available for Navy use, and not a variety of colored glass, which is often the case if care is not taken in the selection and testing of filter lenses.

Recognizing the functions and properties of a good filter lens, care should be exercised in protecting this expensive type of lens from molten metal spatter. A cover lens, a piece of clear glass free from optical imperfections, should be used. These cover glasses or lenses should be frequently changed, as they gradually get covered with molten metal spatter. If these lenses are not changed when in this state, they impair the vision and cause eye strain. A filter lens should never be used without the protection of a cover lens.

Cobalt glass, not effective against ultra-violet.

The blue cobalt glass commonly used by furnace men and steel workers does not provide protection against the ultra-violet radiant energy. Its use should be gradually eliminated as the workmen become experienced in judging temperatures, heats, and flame characteristics with the standard Navy lenses.

Toxic gases.

For the protection of the respiratory organs, good ventilation should be maintained for all working conditions.

The generation of the invisible, odorless, and extremely poisonous gas, carbon monoxide, should be guarded against. The use of coke rivet heaters in small confined apartments is bad practice, as combustion with limited supply of air or oxygen will cause the formation of carbon monoxide, an incomplete product of combustion. Spark retarders in cupolas should not be allowed to become obstructed, for such a condition will cause the cupola gases, consisting of some carbon monoxide, to escape through the charging door and endanger the workmen. Where combustion must take place for industrial activities have good ventilation and sufficient oxygen to give complete products of combustion.

The risk from lead fume in cutting painted surfaces with the oxy-acetylene flame arises chiefly in confined or sheltered places. On this account the general method of procedure should be to "open up," that is, to commence burning on the deck and work downward in order to avoid generating lead fume in confined places.

Conclusion.

The safety engineers and all supervisors should become familiar with the properties, uses, and limitations of all the classes of safety apparatus described and listed in Section II.

The yard chemists, metallurgists, and engineers should always be ready to cooperate and assist the safety engineer and supervisors with their training and experience along special lines.

See that all workmen on jobs and occupations that present hazards to the head, eyes, and respiratory organs are supplied with and use the correct safety protectors.

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